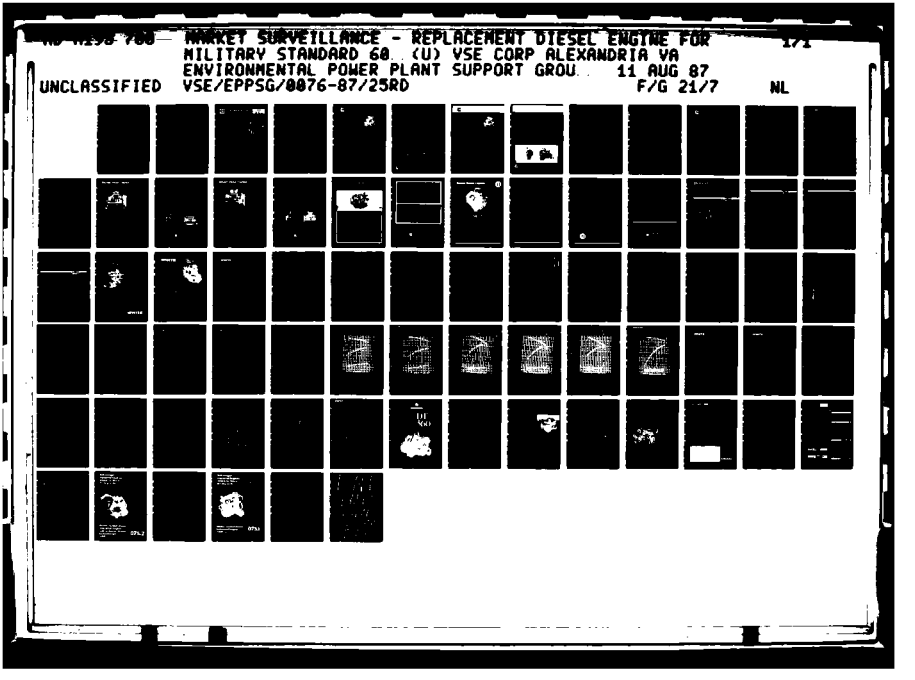
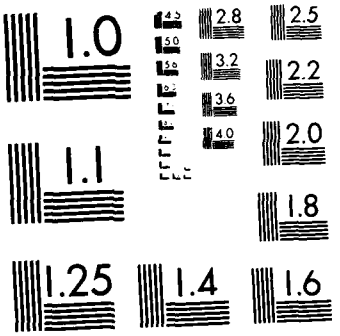

MARKET SURVEILLANCE - REPLACEMENT DIESEL ENGINE FOR
MILITARY STANDARD 60.. (U) VSE CORP ALEXANDRIA VA
ENVIRONMENTAL POWER PLANT SUPPORT GROU.. 11 AUG 87
UNCLASSIFIED VSE/EPPSG/0076-87/25RD F/G 21/7 NL


1.0
1.1
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4.5
5.0
5.6

VSE/EPPSG/0076-87/25RD

MARKET SURVEILLANCE - REPLACEMENT DIESEL ENGINE FOR MILITARY STANDARD 60 KW DIESEL ENGINE DRIVEN GENERATOR SETS MEP-006A, MEP-105A, AND MEP-115A

VSE Corporation
2550 Huntington Avenue
Alexandria, VA 22303-1499

11 August 1987

Manufacturers' Engine Data Collected during the Period 3 June 1987 through 17 July 1987

U.S. Army Belvoir Research, Development and Engineering Center
Power Generation Division (STRBE-FGP)
Fort Belvoir, VA 22060-5606

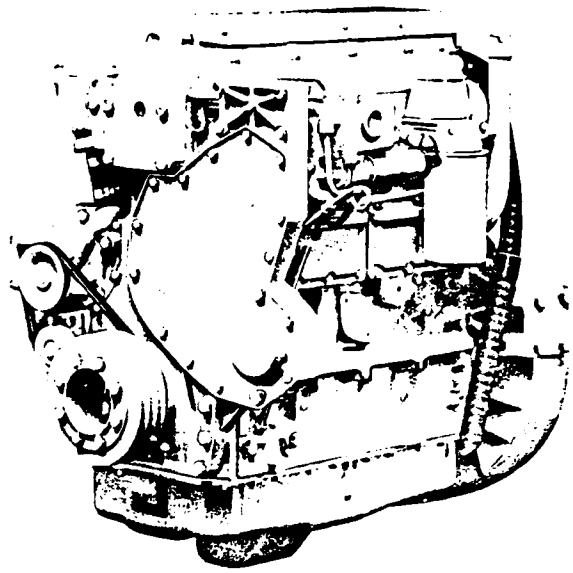
CATERPILLAR
INDUSTRIAL ENGINE

3114
60-104 kW [80-140 hp]

SPECIFICATIONS

In Line 4, 4-Stroke-Cycle-Engine

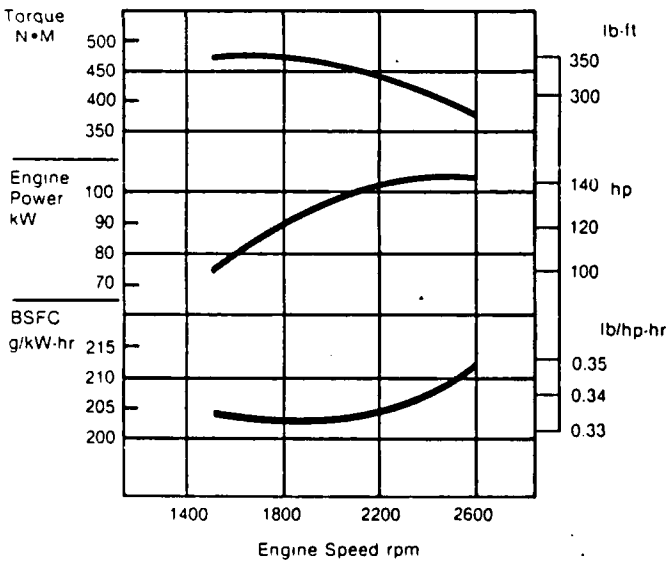
Bore — mm (in)	105 (4.12)
Stroke — mm (in)	127 (5.00)
Displacement — liter (cu in)	4.4 (268)
Combustion System	Direct Injection
Rotation (from flywheel end)	ccw
Capacity for Liquids — liter (U.S. gal)	
Cooling System (engine only)	10.0 (2.64)
Lube Oil System (refill)	9.5 (2.50)
Weight, Net Dry (approximate) — kg (lb)	
Turbocharged (T)	400 (880)
Engine Speed — rpm	2000-2800
Altitude Capability — m (ft)	1524 (5000)



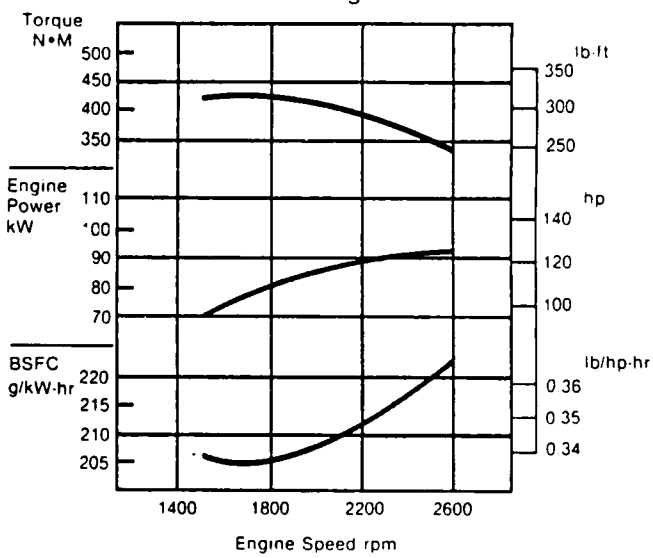
PERFORMANCE DATA

Power Ratings

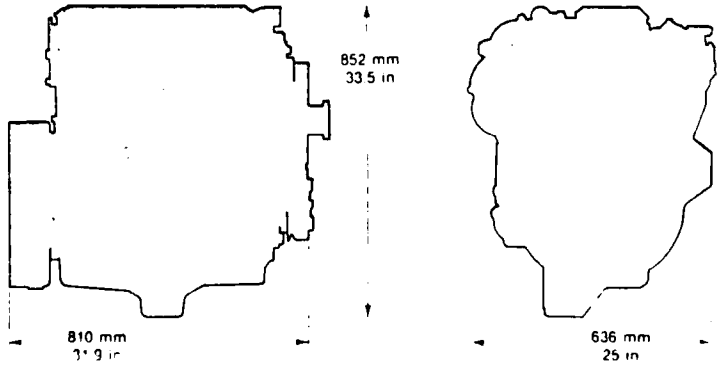
Turbocharged-Aftercooled



Turbocharged



DIMENSIONS



3114 Industrial 60 - 104 kW (80-140 hp)

CATERPILLAR

STANDARD EQUIPMENT

- Cooling
  lube oil, jacket water pump, thermostats
- Flywheel Housing, SAE No. 2
- Fuel
  transfer pump, filter
- Lubricating
  oil cooler, oil filter
- Exhaust
  flexible fittings, muffler, alternate turbo locations
- Flywheel Housing
  Flywheels
- Instruments and Gauges
  instrument panel, fuel pressure and lube oil pressure gauges, service meter, tachometer
- Lubricating
  dipstick, oil filler, oil filter, oil pans
- Power Takeoffs
  auxiliary drive pulleys, rear enclosed clutches, front PTO
- Protection Devices
  electrical and mechanical shutoffs, oil pressure and water temperature alarm switches
- Starting
  electric

ACCESSORY EQUIPMENT

- Air Intake
  single stage, dry air cleaner
- Alternators
- Cooling
  radiator, fan drive, belt tightener, Vee belt

RATINGS

Intermittent Ratings*						
Model	Power		Speed	Peak Torque		Speed
	kW	HP	rpm	N•m	lb•ft	rpm
3114 TA	104	140	2600	481	354	1650
3114 T	93	125	2600	430	316	1650
3114 T	86	115	2600	394	290	1650

*Additional intermittent ratings available at 2800, 2400, and 2200 rpm; continuous ratings available at 2200 rpm and below.

RATING DEFINITIONS

Intermittent

Intermittent is the horsepower and speed capability of the engine which can be used for about one hour, followed by an hour of operation at or below the continuous rating.

Continuous

Continuous is the horsepower and speed capability of the engine which can be used without interruption or load cycling.

Additional ratings are available for specific customer requirements. Consult your Caterpillar Dealer.

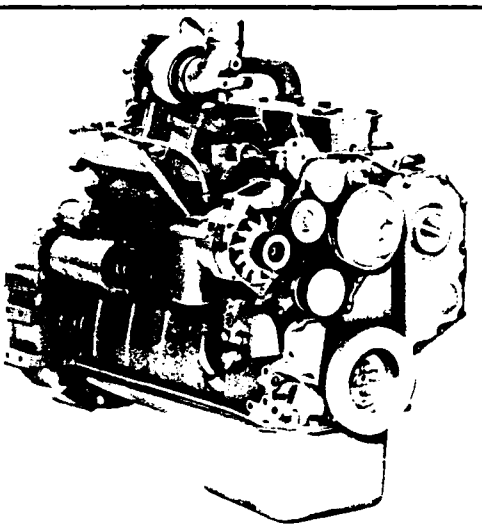
RATING CONDITIONS

Ratings are based on SAE J1349 standard conditions of 100 kPa (29.61 in Hg) and 25°C (77°F). These ratings also apply at ISO 3046/1, DIN 6271 and BS 5514 standard conditions of 100 kPa (29.61 in Hg), 27°C (81°F) and 60% relative humidity.

Fuel consumption is based on fuel oil having an LHV of 42,780 kJ/kg (18,390 Btu/lb) and weighing 838.9 g/liter (7.001 lb/U.S. gal).

Engine equipped with fuel, lube oil and jacket water pumps but without fan.

6BT5.9-G1
GENERATOR DRIVE

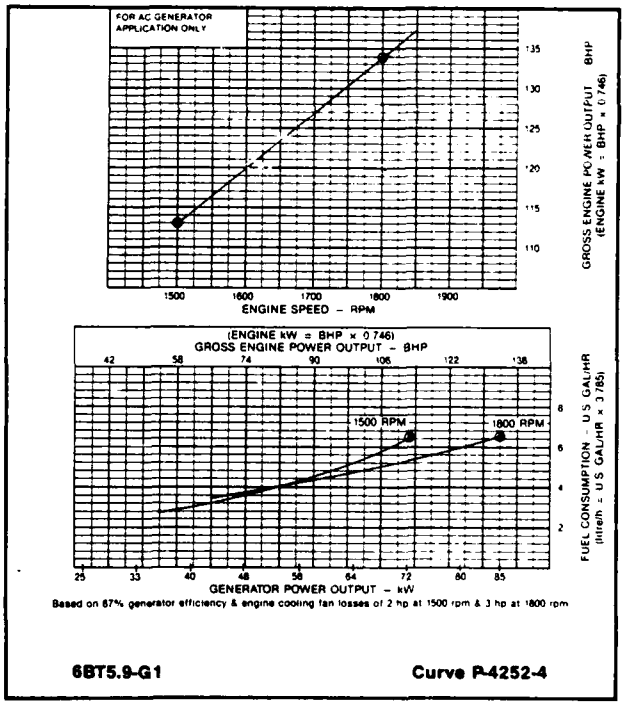


SPECIFICATIONS

Four Stroke Cycle, Turbocharged, Direct Injection, In-Line, 6 Cylinder Diesel Engine.

Power Rating @ 1800 rpm* 100 kW		**(134 bhp)**
Power Rating @ 1500 rpm* 84 kW		**(113 bhp)**
Bore and Stroke	102 x 120 mm	(4.02 x 4.72 in.)
Piston Displacement	5.88 L	(359.0 cu. in.)
Compression Ratio	17.5:1	(17.5:1)
Dry weight with flywheel housing, less flywheel and electrics	399 kg	(880 lbs.)

*** Refers to gross power available from engine, not generator set.**



PERFORMANCE: Engine performance at ISO 3046 standard conditions of 100 kPa (29.61 inches Hg) dry barometer, 27°C (81°F) air intake temperature, and 2 kPa (0.63 inches Hg) water vapor pressure with No. 2 diesel fuel will be within ± 5% of that shown on a typical engine after break-in. Actual performance may vary with different ambient conditions.

These ratings refer to gross engine power output and are applicable for continuous service and conform with both ISO 3046 overload power and fuel stop power. These ratings should be divided by 1.1 for applications requiring 10% overload, and will then conform with ISO 3046 continuous power for generator set applications. BS 5514 and DIN 6271 conform with ISO 3046.

The engine may be applied up to 2 250 m (7,500 ft.) elevation and 50°C (122°F) ambient without deration.

Curves represent performance of the engine with water pump, lubricating oil pump, fuel system and air cleaner; not included are alternator, fan and optional equipment.

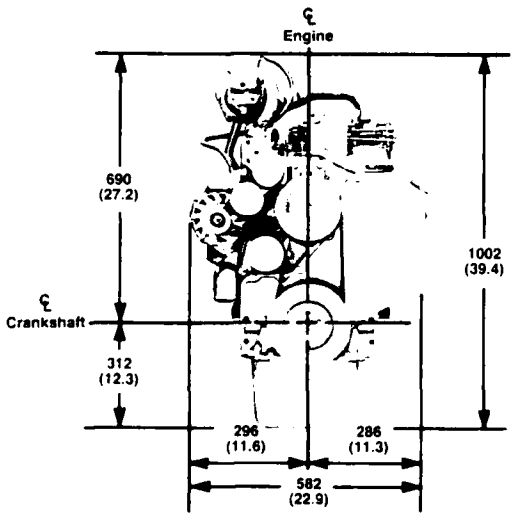
6BT5.9-G1
GENERATOR DRIVE

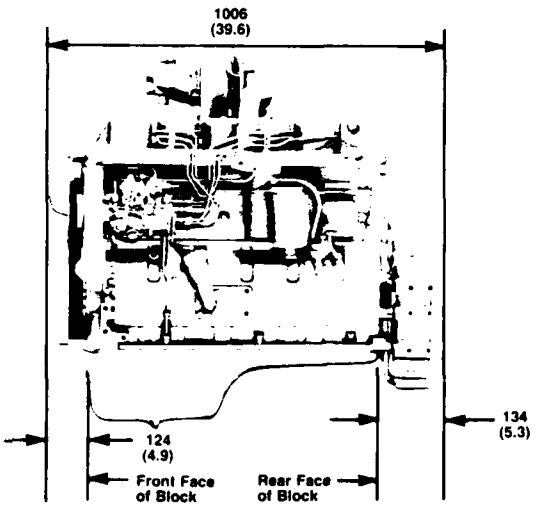
DESIGN FEATURES

Cast Iron Skirted Block: With main bearing supports between each cylinder, for maximum strength and rigidity, low weight, and optimum crankshaft support.
Compact Size: For ease of installation and easy access for routine maintenance.
Direct Fuel Injection System: With high swirl intake ports for thorough mixing of air and fuel to provide low fuel consumption.
Fewer Parts: For less inventory and faster maintenance and repair. Parts simplicity also enables engines to be serviced and repaired with ordinary hand tools.
Forged Steel Crankshaft: With integral counterweights, allowing high power output from a compact size.
Forged Steel, I-Beam Cross Section Connecting Rods: With angle split cap-to-rod interface and capscrew attachment for maximum structural strength and ease of service.
Side Mounted Gear Driven Camshaft: For low engine height and minimum maintenance.
Single Belt Fan, Alternator, and Water Pump Drive: With self-tensioning idler for minimum belt maintenance.
Single Piece Cross Flow Cylinder Head: For short length and maximum structural stiffness of the block/head assembly, for fewer head gasket problems.
Turbocharger: Holset exhaust gas driven turbocharger mounted at top of engine. Turbocharging provides increased power, improved fuel economy, altitude compensation, and lower smoke and noise levels.
Two Valves Per Cylinder: With single valve springs, for fewer parts.

AVAILABLE EQUIPMENT

Accessory Drive Pulley: Mounted on fan hub for driving accessories.
Alternator: 12 volt with output of 65 amps.
Exhaust Accessories: Various flanges, connections and clamps for adapting to exhaust piping.
Fan Drive: Fan center of 296 mm (11.7 in.) and drive ratio of 1.35 times engine speed.
Flywheel: To fit 314 mm (12⅜ in.) diameter generator drive disc.
Flywheel Housing: Aluminum SAE No. 3.
Front Engine Support: For single point mounting.
Governor: Lucas CAV fuel pump with mechanical 4% droop governor or American Bosch ICD 67 electronic governor for single unit isochronous operation.
Oil Pan: Rear sump type.
Starter: 12 volt, positive engagement.
Water Inlet Connection: Pointing to front 30° down.

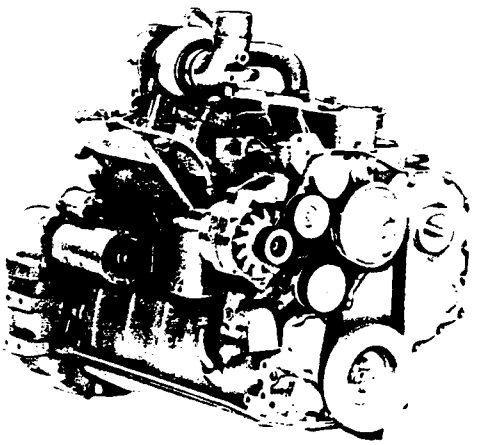




Cummins Engine Company, Inc.
Columbus, IN 47202
U.S.A.

Bulletin 3380591 Printed in U.S.A. Rev. 9/85

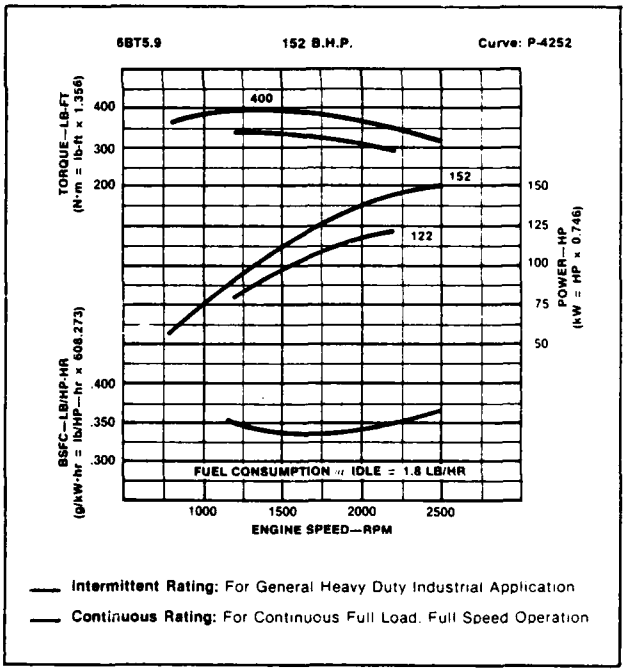
6BT5.9
INDUSTRIAL DIESEL



SPECIFICATIONS

Four Stroke Cycle, Turbocharged, In-Line, 6 Cylinder Diesel Engine

Power Rating	113 kW	(152 bhp)
Rated Speed	2500 rpm	(2500 rpm)
Peak Torque (1500 rpm)	542 N•m	(400 lb. ft.)
Nominal Torque Rise	25%	(25%)
Bore and Stroke	102 x 120 mm	(4.02 x 4.72 in.)
Piston Displacement	5.88 L	(359.0 cu. in.)
Compression Ratio	17.5:1	(17.5:1)
Dry weight with flywheel housing, less flywheel and electrics	399 kg	(880 lbs.)



Intermittent Rating: For General Heavy Duty Industrial Application

Continuous Rating: For Continuous Full Load, Full Speed Operation

PERFORMANCE: Engine performance at SAE standard J1349 conditions of 99 kPa (29.31 inches Hg) dry barometer, 25° C (77° F) air intake temperature, and 1 kPa (0.30 inches Hg) water vapor pressure with No. 2 diesel fuel will be within ± 5% of that shown on a typical engine after break-in. Actual performance may vary with different ambient conditions.

Curves represent performance of the engine with water pump, lubricating oil pump, fuel system, and air cleaner; not included are alternator, fan and optional equipment.

6BT5.9
INDUSTRIAL DIESEL

DESIGN FEATURES

Direct fuel injection system with high swirl intake ports for thorough mixing of air and fuel to provide low fuel consumption.

Holset exhaust gas driven turbocharger provides more power, improved fuel economy, altitude compensation, and lower smoke and noise levels.

Compact size for ease of installation and easy access for routine maintenance.

Fewer parts, for less inventory and faster maintenance and repair. Parts simplicity also enables engines to be serviced and repaired with ordinary hand tools.

Cast iron skirted block, with main bearing supports between each cylinder, for maximum strength and rigidity, low weight, and optimum crankshaft support.

Forged steel, I-beam cross section connecting rods with angle split cap-to-rod interface and capscrew attachment for maximum structural strength and ease of service.

Forged steel crankshaft, with integral counterweights, allowing high power output from a compact size.

Side mounted gear driven camshaft, for low engine height and minimum maintenance.

Single piece cross flow cylinder head, for short length and maximum structural stiffness of the block/head assembly, for fewer head gasket problems.

Two valves per cylinder, with single valve springs, for fewer parts.

Single belt fan, alternator, and water pump drive with self-tensioning idler for minimum belt maintenance.

AVAILABLE EQUIPMENT

Air Compressor: Bendix or Wabco single cylinder compressor.

Air Intake Accessories: Hump hoses, elbows, and clamps for adapting to various piping sizes.

Accessory Drive Pulley: Mounted on fan hub for driving freon compressor or other accessories.

Alternators: 12 or 24 volt with outputs ranging from 35 to 105 amps.

Exhaust Accessories: Various flanges, connections, and clamps for adapting to exhaust piping.

Fan Drives: Fan centers from 203 mm (8.0 in.) to 444 mm (17.5 in.) and drive ratios of 1.1 and 1.35 times engine speed.

Flywheels: To fit various clutches, torque converters, and transmissions.

Flywheel Housings: Aluminum, SAE No. 2 or SAE No. 3.

Freon Compressor Mountings: To fit various rotary and reciprocating compressors.

Front Power Takeoff: Pulley and adapters for belt or direct drives.

Front Engine Supports: For single point or barrel mountings.

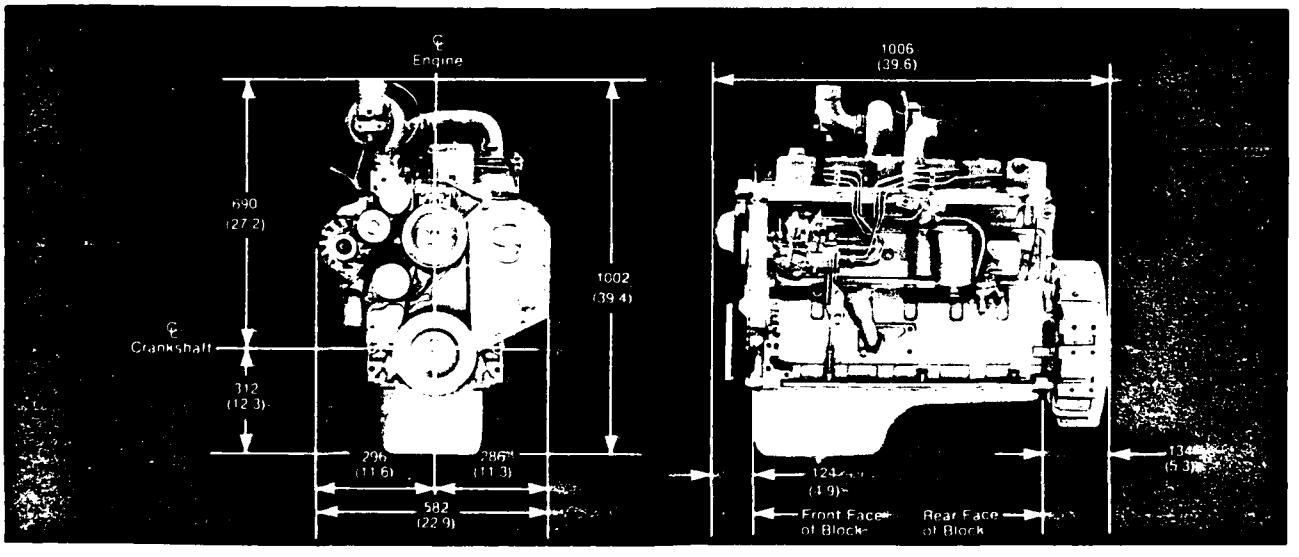
Hydraulic Pump Drives: Direct drive SAE A or SAE B flanges.

Oil Pans: Front or rear sump types with angularity capability of 45°.

Starters: 12 or 24 volt, positive engagement.

Turbocharger Locations: High mount with exhaust to front or rear.

Water Inlet Connections: Pointing to front 30° down or 73° down, or pointing straight out to side.



Cummins Engine Company, Inc.
Columbus, Indiana
47202

Cummins has always been a pioneer in product improvement. Thus specifications may change without notice. Illustrations may include optional equipment.

Bulletin 3380529 Printed in U.S.A. Rev. 7/85

CUMMINS ENGINE COMPANY, INC.

Engine Data Sheet

Engine Model: 6BT5.9G1 **Date:** 12/22/86 **Bulletin:** 3383823

GENERAL ENGINE DATA

Type	6 cylinder, 4 cycle
Aspiration	Turbocharged
Bore — in. (mm) x stroke — in. (mm)	4.02(102) x 4.72(120)
Displacement — in³ (litre)	359(5.88)
Compression Ratio	17.5:1

	Dry Type Exhaust Manifold lb. (kg)	Water Cooled Exhaust Manifold lb. (kg)
Dry Weight		
Engine only per Installation Diagram	765(347)	809(367)
Radiator Cooled Engine without Main Generator per Installation Diagram	1905(864)	1949(884)
Heat Exchanger Cooled Engine without Main Generator per Installation Diagram	NA	NA
Wet Weight		
Engine only per Installation Diagram	817(370)	861(391)
Radiator Cooled Engine without Main Generator per Installation Diagram	1970(895)	2014(914)
Heat Exchanger Cooled Engine without Main Generator per Installation Diagram	NA	NA

Moment of Inertia of Rotating Components (exclusive of Flywheel) — $lb_m \cdot ft^2$ ($kg \cdot m^2$) ..... 5.98(0.245)

Cyclic Speed Variation with FW Flywheel at 1800 rpm; 1500 rpm .....

ENGINE MOUNTING

Maximum Bending Moment at Rear Face of Block — lb. ft. (N·m) ..... 1000(1360)

EXHAUST SYSTEM

Maximum Back Pressure — in. Hg (mm Hg) ..... 3(75)

AIR INDUCTION SYSTEM

Maximum Intake Air Restriction — With Dirty Filter Element — in. H_2O (mm H_2O) ..... 25(635)
— With Heavy Duty Air Cleaner and Clean Filter Element — in. H_2O (mm H_2O) ..... 12(305)
— With Light Duty Air Cleaner and Clean Filter Element — in. H_2O (mm H_2O) ..... 12(305)
Minimum Dirt Holding Capacity — Heavy Duty Air Cleaner — g/CFM (g·litre⁻¹·sec.) ..... 18(38)
— Light Duty Air Cleaner — g/CFM (g·litre⁻¹·sec.) ..... 3(6.4)

COOLING SYSTEM

	Dry Type Exhaust Manifold	Water Cooled Exhaust Manifold
Coolant Capacity — Engine only — U.S. quart (litre)	11.1(10.5)	12.6(11.9)
— With 100°F Radiator — U.S. quart (litre)	19.7(18.6)	21.2(20)
— With Heat Exchanger — U.S. quart (litre)	NA	NA

Maximum Coolant Friction Head External to Engine — PSI (kPa) ..... 5.0(35)
Maximum Static Head of Coolant Above Engine Crank Centerline — ft. (metre) ..... 46(14)
Maximum Air Restriction on Discharge Side of HX Radiator and Fan — in. H_2O (mm H_2O) ..... 0.25(6.3)
Minimum Raw Water Flow @ 90°F to HX Heat Exchanger — U.S. GPM (litre/min.) ..... NA
Maximum Raw Water Inlet Pressure at HX Heat Exchanger — PSI (kPa) ..... NA
Standard Thermostat (modulating) Range — °F (°C) ..... 175-195(80-90)
Maximum Output Pressure of Engine Water Pump (exclusive of pressure cap) — PSI (kPa) ..... 20(137.9)
Minimum Pressure Cap — PSI (kPa) ..... 15(103)
Maximum Top Tank Temperatue — °F (°C) ..... 230(110)
Minimum Top Tank Temperature — °F (°C) ..... 175(80)
Minimum Fill Rate — U.S. GPM (litre/min.) ..... 5.0(4.7)
Maximum Initial Fill Time — With Engine Mounted Radiator — min. ..... NA
Minimum Coolant Expansion Space — % of System Capacity 4-6%
Maximum Deaeration Time — min. 25
Drawdown* Must Exceed the Volume Not Filled at Initial Fill
Minimum Allowable Drawdown* — U.S. quart (litre) ..... NA

Drawdown does not include expansion space. It is suggested that initial design be at least 10% of system capacity.

LUBRICATION SYSTEM

Oil Pressure @ Idle — PSI (kPa) ..... 30-40(210-275)
@ Rated Speed — PSI (kPa) ..... 35-55(240-380)
Maximum Oil Temperature — °F (°C) ..... 250(121)
Maximum Oil Consumption — U.S. quart/hr. (litre/hr.) ..... 0.25(0.24)
By-Pass Filter Size — in³ (litre) ..... NA
By-Pass Filter Capacity — U.S. gal. (litre) ..... NA
Oil Capacity (Oil Pan Option No. OP); High-Low — U.S. gal. (litre) ..... 10(9.5)
Total System Capacity (including by-pass filter) — U.S. gal. (litre) ..... 11.6(11)
Angularity of OP Oil Pan — Front Down ..... 45°
— Front Up ..... 45°
— Side to Side ..... 45°

FUEL SYSTEM

Type Injection System ..... CAV
Maximum Restriction to PT Fuel Injection Pump — With Clean Fuel Filter — in. Hg (mm Hg) ..... NA
— With Dirty Fuel Filter — in. Hg (mm Hg) ..... 3.5(89)
Maximum Injector Return Line Restriction — in. Hg (mm Hg) ..... 10(69)
Maximum Fuel Flow to Pump — U.S. GPH (litre/hr.) ..... 8.19(30.9)

ELECTRICAL SYSTEM

	12 volt	24 vo
Battery Charging System, 12/24 volt options available		
Cranking Motor (Heavy Duty, Positive Engagement) — Volt	12/24	
Maximum Allowable Resistance of Cranking Circuit — Ohm	.0012	.002
Minimum Recommended Battery Capacity		
Cold Soak @ 50°F (10°C) and above — 0°F CCA	500 est	
Cold Soak @ 32°F to 50°F (0°C to 10°C) — 0°F CCA	700 est	
Cold Soak @ 0°F to 32°F (−18°C to 0°C) — 0°F CCA	950	
Cranking Motor Current Based on Lube Oil Viscosity per Bulletin 3379002		
Breakaway Current at Zero RPM @ 50°F (10°C) — Amp	1170 est	
Breakaway Current at Zero RPM @ 32°F (0°C) — Amp	1320 est	
Breakaway Current at Zero RPM @ 0°F (−18°C) — Amp	1920	
Cranking Current @ 50°F (10°C) — Amp	590 est	
Cranking Current @ 32°F (0°C) — Amp	660 est	
Cranking Current @ 0°F (−18°C) — Amp	980	

PERFORMANCE DATA

Steady-State Speed Stability Band at any Constant Load — %	.33
Maximum Overspeed Capability — RPM	2250
Estimated Free Field Sound Pressure Level @ 3 ft. (1 m) — dBA	92

Excludes Noise from Intake, Exhaust, Cooling System & Driven Components.

All data represent gross engine performance capabilities obtained and corrected in accordance with ISO-3046 conditions of 29.61 in. Hg (100 kPa) barometric pressure (300 ft. (90 m) altitude), 81°F (27°C) inlet air temperature, and 0.63 in. Hg (2 kPa) water vapor pressure (60% relative humidity) with No. 2 diesel fuel or a fuel corresponding to ASTM D2. Data is based on the engine operating with fuel system, water pump and lubricating oil pump; not included are battery charging alternator, fan, optional equipment and driven components.

Chart below reflects data based on following variables at conditions of rated power:

Coolant Temperature — °F (°C)	190(88)	Air Intake Restriction — in. H_2O (mm H_2O)	10(2
Water Inlet Pressure — PSI (kPa)	7.0(50)	Inlet Air Temperature — °F (°C)	77(2
Water Pressure in Engine Block — PSI (kPa)		Exhaust Restriction — in. Hg (mm Hg)	2(50

	Max Rating		With 10% Overload	
	60 Hz	50 Hz	60 Hz	50 Hz
Engine Speed — RPM	1800	1500	1800	1500
Gross Engine Power Output — BHP (kW)	135(101)	115(85.7)	121(90.9)	104(77.9
Brake Mean Effective Pressure — PSI (kPa)	166(1138)	166(1145)	150(1034)	150(1034)
Piston Speed — ft./min. (m/s)	1417(7.2)	1181(6)	1417(7.2)	1181(6)
Maximum Regenerative Power Absorption Capacity — kW	22.3(16.6)	19.5(14.5)	22.3(16.6)	19.5(14.5)
Engine Water Flow — U.S. GPM (litre/s)	40(2.5)	35(2.2)	40(2.5)	35(2.2)
Engine Data with Dry Type Exhaust Manifold				
Net Engine Power With				
100°F HX Radiator and Fan — BHP (kW)	125(93.2)	109(81.2)	112(83.5)	99(73.8)
125°F HX Radiator and Fan — BHP (kW)	125(93.2)	109(81.2)	112(83.5)	99(73.8)
Intake Air Flow — CFM (litre/s)	224(106)	166(78)	215(101)	150(71)
Exhaust Gas Temperature — °F (°C)	885(474)	955(501)	830(443)	840(449)
Exhaust Gas Flow — CFM (litre/s)	585(276)	447(211)	538(254)	378(178)
Radiated Heat to Ambient — BTU/min. (kW)	850(15)	780(14)	770(13)	710(12)
Heat Rejection to Coolant — BTU/min. (kW)	3140(55)	2750(48)	2830(50)	2500(44)
Heat Rejection to Exhaust — BTU/min. (kW)	4550(80)	3840(68)	4110(72)	3500(61)
Cooling Fan Air Flow with				
100°F HX Radiator and Fan — CFM (litre/s)	6441(3040)	5353(2527)	6441(3040)	5353(2527
125°F HX Radiator and Fan — CFM (litre/s)				
Engine Data with Water Cooled Exhaust Manifold				
Net Engine Power With				
100°F HX Radiator and Fan — BHP (kW)	125(93.2)	109(81.2)	112(83.5)	99(73.8)
125°F HX Radiator and Fan — BHP (kW)	125(93.2)	109(81.2)	112(83.5)	99(73.8)
Intake Air Flow — CFM (litre/s)	233(110)	198(94)	226(107)	190(90)
Exhaust Gas Temperature — °F (°C)	730(388)	780(416)	675(357)	700(371)
Exhaust Gas Flow — CFM (litre/s)	538(254)	477(226)	498(235)	428(202)
Radiated Heat to Ambient — BTU/min. (kW)	789(14)	661(12)	707(12)	596(10)
Heat Rejection to Coolant — BTU/min. (kW)	4266(75)	3570(63)	3823(67)	3223(57)
Heat Rejection to Exhaust — BTU/min. (kW)	3363(59)	2901(51)	3054(54)	2663(47)
Cooling Fan Air Flow With				
100°F HX Radiator and Fan — CFM (litre/s)				
125°F HX Radiator and Fan — CFM (litre/s)				

REFERENCE INFORMATION

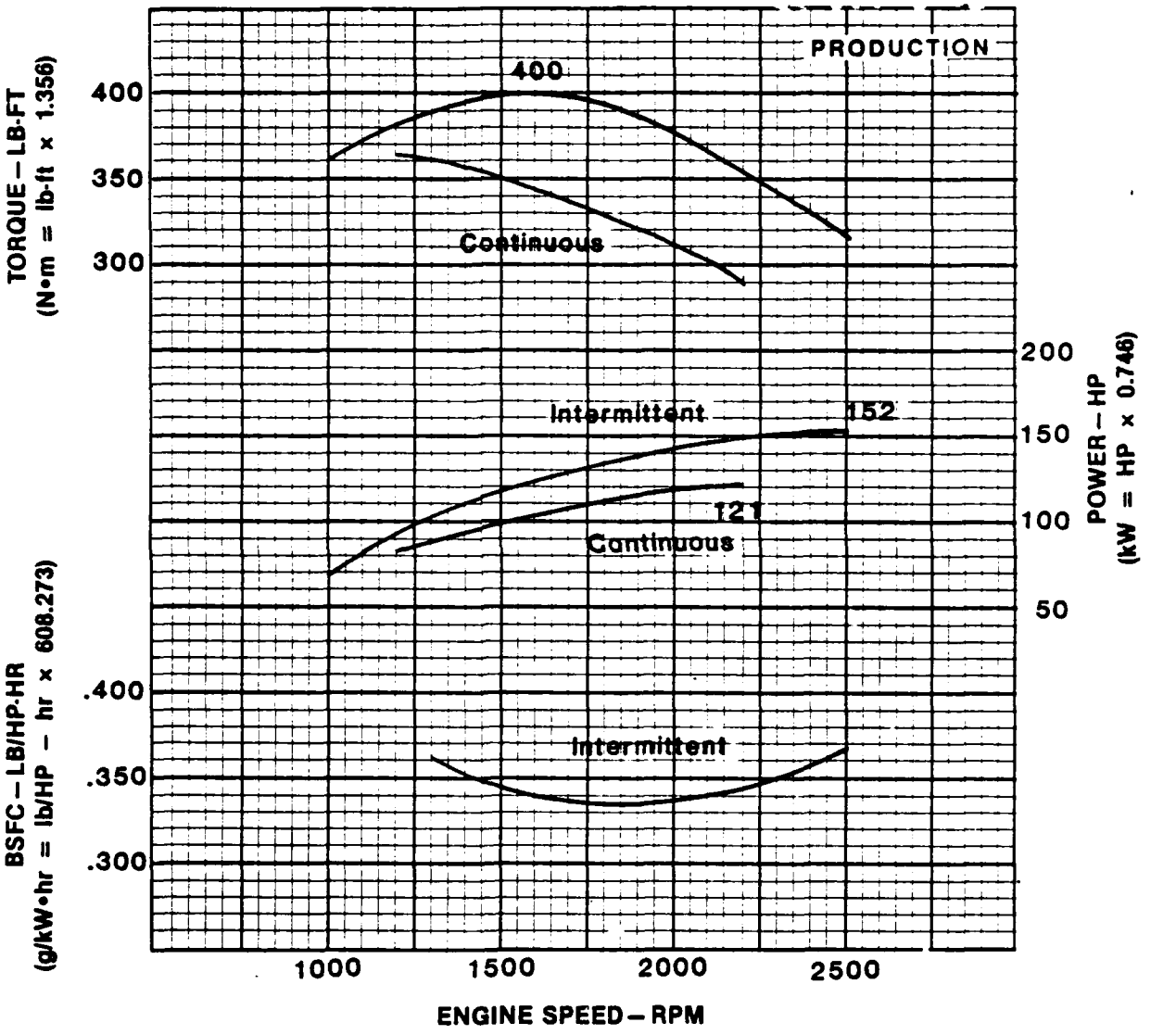
Performance Curve	4252-4A
Wiring Diagram	
Installation Diagram	
— Engine Only	3904681
— With Radiator	3905981
— With Heat Exchanger	
— For Remote Cooling	

Engine Model: 6BT5.9 G1
Data Sheet:
Date: 12/22/86
Bulletin No.: Bulletin 3383823

Engine Performance Curve

ENGINE MODEL:	CURVE NUMBER:
6BT5.9	**4252-B**
	DATE: **11-12-86** / CPL CODE: **0938**

BORE:	102 mm (4.02 in.)	NO. OF CYLINDERS:	6
STROKE:	120 mm (4.72 in.)	ASPIRATION:	Turbocharged
DISPLACEMENT:	5.88 litres (359 in.^{3})	DRY WEIGHT:	399 kg (880 lb.)



Intermittent Rating: For general heavy duty industrial applications
Continuous Rating: For continuous full load, full speed operations

Approved By:

Power ±5% based on a typical engine after break-in.

Data Based on SAE J1349

Barometer	100 kPa (29.61 in. Hg)
Intake Air Temperature	25°C (77°F)
Intake Air Restriction	250 mm (10 in.) H_2O
Exhaust Restriction	50 mm (2 in.) Hg
Coolant Temperature	88°C (190°F
Coolant Intake Pressure	50 kPa (7 psi
Fuel Inlet Temperature	40°C (104°F
Fuel	No. 2 Diese
Lube Oil Viscosity	SAE 15W-4(

MODEL: 6BT5.9 DATE: 11-12-86 NUMBER: 4252-B

General Engine Data

Type	In-Line, Liquid Cooled, 4-Stroke Cycle
Aspiration	Turbocharged
Bore x Stroke - mm (in.)	102 (4.02) x 120 (4.72)
Displacement - litres (in.³)	5.88 (359)
Compression Ratio	18.5:1
Firing Order	1-5-3-6-2-4
Rotation, Viewed from Front of Engine	Clockwise
Engine Weight (with flywheel housing, flywheel and electrics)	
Dry - kg (lb.)	399 (880)
Wet - kg (lb.)	423 (933)
CG Distance from Front Face of Block - mm (in.)	338 (13.3)
CG Distance Above Crank Centerline - mm (in.)	155 (6.1)
Intertia of Rotating Components (Less Flywheel) - kg•m² (lb.-ft.²)	0.247 (5.86)
Coolant Capacity (Engine Only) - litres (U.S. qt.)	10.5 (11.1)
Thermostat - °C (°F)	83 (181)
Oil Capacity	
Pan - litres (U.S. qt.)	14.3 (15.0)
Total - litres (U.S. qt.)	16.4 (17.3)

Oil Pressure	Minimum	Typical
At Rated Speed - kPa (psi)	207 (30)	345 (50)
At Idle - kPa (psi)	69 (10)	207 (30)

Angularity of Standard Pan - all directions	35°
Idle Speed (typical) - rpm	800
Governor Regulation (typical) - %	6-10
Maximum Overspeed Capability - rpm	4200
Thrust Bearing Load Limit	
Maximum Intermittent - N (lb.)	3781 (850)
Maximum Continuous - N (lb.)	1 780 (400)
Torque Output @ 800 rpm - N•m (lb-ft)	342 (252)
Friction @ 2500 rpm - kW (hp)	31.5 (42.2)
Altitude Capability - Derate 4% per 300 m (1000 ft.) Above:	
Transient - m (ft.)	3 000 (9850)
Continuous - m (ft.)	2 250 (7400)
Standard Installation Drawing	3904681

Performance Data

Engine Speed rpm	Power Output kW (hp)	Torque N•m (lb-ft)	Intake Air Flow litre/s (cfm)	Exhaust Gas Flow litre/s (cfm)	Exhaust Gas Temp. °C (°F)	Engine Water Flow litre/s (gpm)	Heat Rejection kW (Btu/min.)	Noise Level 1m•dBA
2500	115 (152)	Std. Rating FR9036	181 (383)	496 (1052)	546 (1015)	3.6 (57)	52.7 (3000)	97.5
1600	Peak Torque	542 (400)	104 (220)	301 (639)	593 (1100)	2.2 (35)	40.9 (2325)	
2200	90 (121)	Cont. Rating FR9109	139 (295)	365 (775)	510 (950)		39.6 (2250)	

- Heat Rejection data based on stabilized 99°C (210°F) top tank and 100% water coolant.
- Noise levels 1 meter soft cell
- Intake and exhaust flows based on 250 mm (10 in.) H O intake restriction and 50 mm (2 in.) Hg exhaust restriction.

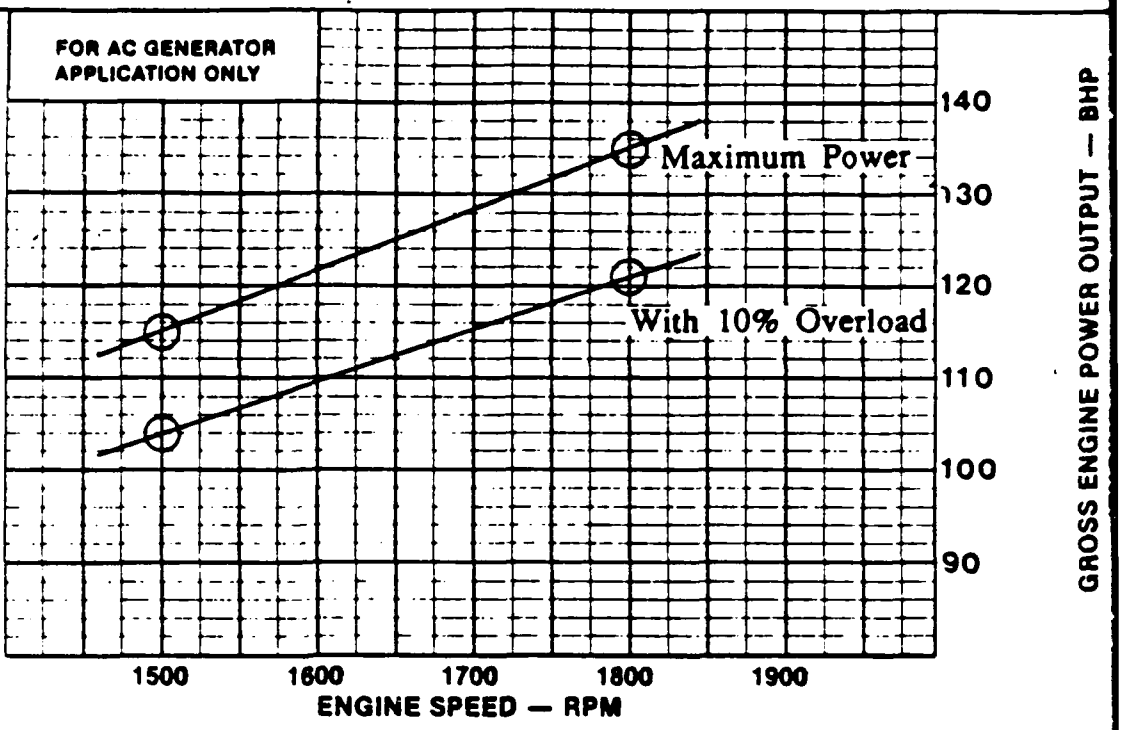
Bulletin 3383758 Printed in U.S.A. 11.86

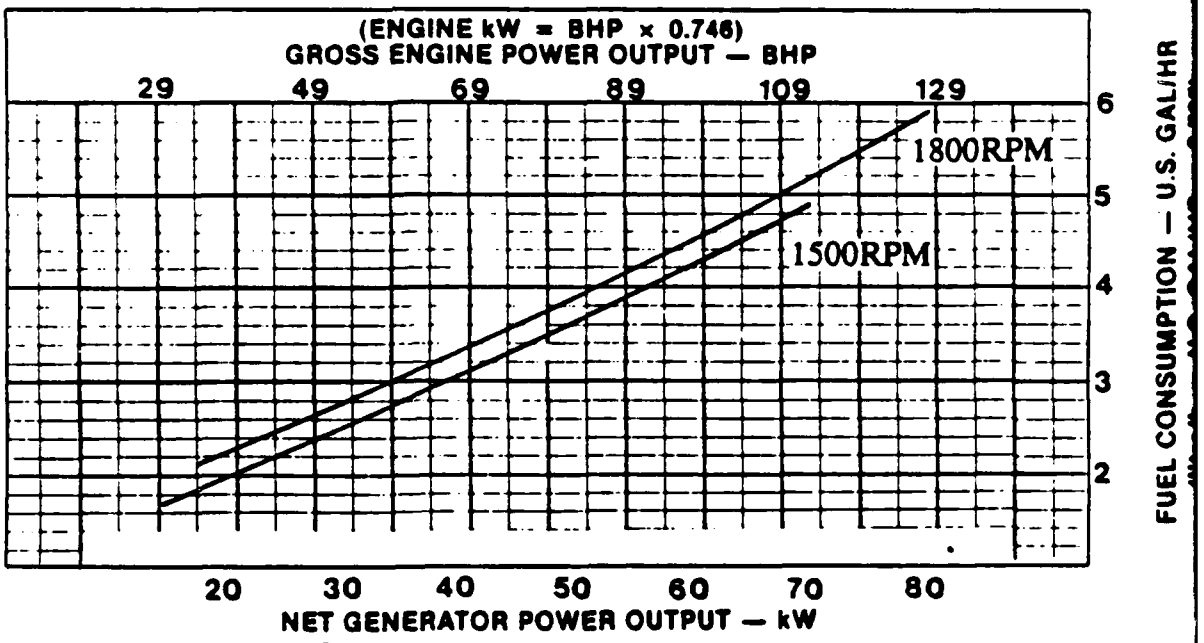
CUMMINS ENGINE COMPANY, INC. Columbus, Indiana 47201	6BT5.9 G1	4252-4A
G/GS/GC 1 Drive	ASPIRATION: Turbocharged	DATE: Dec, '86 | D.R

DISPLACEMENT: 359.0 in³ (5.88 litre) **NO. OF CYLINDERS:** 6 **RATING:** HP (kW) @ RPM

BORE: 4.02 in. (102 mm) **STROKE:** 4.72 in. (120 mm) 135hp (100kW) @ 1800 RP

Power output curves are based on the engine operating with fuel system, water pump and lubricating oil pump; not included are ba charging alternator, fan, optional equipment and driven components.





Based on 88 % generator efficiency and engine cooling fan losses of 6.5HP

Curves shown above represent gross engine performance capabilities obtained and corrected in accordance with ISO-3046 conditio of 29.61 in. Hg (100 kPa) barometric pressure [300 ft. (90 m) altitude], 81 °F (27 °C) inlet air temperature, and 0.63 in. Hg (2 kPa) wat vapor pressure (60% relative humidity) with No. 2 diesel fuel. The prime power curve corresponds to ISO-3046 continuous power a the stand-by curve corresponds to both ISO-3046 overload power and fuel stop power.

The fuel consumption data is based on No. 2 diesel fuel weight at 7.1 lbs./U.S. gal. (0.85 kg/litre).

See reverse side for application rating guidelines.

STANDARDS DEPT. **CERTIFIED WITHIN 5%:** **CHIEF ENGINE**

Form 4719 0283R

RATING GUIDELINES

These guidelines are for general purpose use in applying engines to AC Generator Set applications.

MAXIMUM RATING is applicable for supplying electric power in the event of normal utility power failure. No overload capability is available for this rating. This rating may be used for continuous service for as long as the emergency may last. This rating conforms to ISO-3046 overload power and fuel stop power.

FOR RATING WITH 10% OVERLOAD divide the maximum rating by 1.1. This rating may be used for continous service in commercial applications and it conforms to ISO-3046 continuous power, BS 5514 and DIN 6271 conform with ISO-3046.

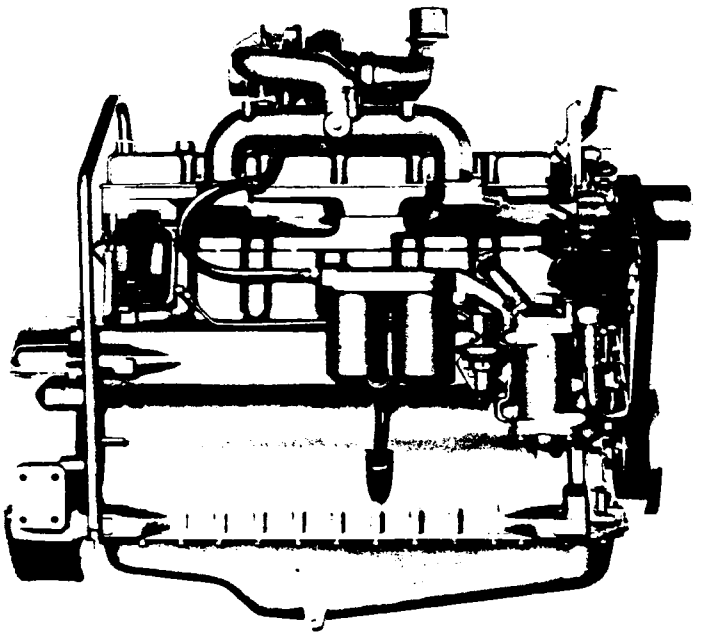
OPERATION AT ELEVATED TEMPERATURE AND ALTITUDE: The engine is fueled for the MAXIMUM POWER RATING and may be operated without changing the fuel setting up to 2250m (7500ft) altitude 38°C (100°F) ambient temperature. For sustained operation at higher altitudes and temperatures the fuel rate of the engines should be adjusted to limit performance by 4% per 300m (1000ft) above 2250m (7500ft) and 2% per 11°C above 38°C (1% per 10°F above 100°F).

→ 77°F

Detroit Diesel Engines

INDUSTRIAL MODELS

Series 30
6414T
142 Hp



ENGINE DESCRIPTION: F063-9301

Type: 6-cylinder valve-in-head, turbocharged
Bore/stroke: 4.19 in x 5.00 in (106 mm x 127 mm)
Displacement: 414 cu in (6.8 L)
Basic weight (approx.): 1324 lb (602 kg)
Power: 142 hp (106 kW) @ 2200 rpm

FEATURES:

Heavy-duty, one-piece, gray-iron cylinder block with deep, thick-ribbed skirts.
Heat-treated, forged-steel crankshaft, dynamically balanced.
Forged-steel connecting rods with precision-machined square-tongue-and-grooves.
Centrifugally cast cylinder liners, wet-sleeve flanged design, individually replaceable.
Crankshaft-driven, positive gear-type lubricating pump.
Small-diameter nozzles with exclusive edge-filter design.
Compact distributor-type injection pump contains fuel filter, built-in transfer pump, temperature-compensating system, speed advance, and an electric shut-off.
Oil spray piston cooling.

STANDARD EQUIPMENT:

Water and oil pumps
Oil pan
Engine oil cooler
Oil and fuel filters
Fuel-injection system complete (includes governor)
Intake and exhaust manifolds
Alternator: 12 volt, 63 amp w/regulator
Starter: 12 volt (no battery and cables)
Flywheel housing: SAE No. 3
Fuel-transfer pump
Lifter eyes
Flywheel: For 11.5 in (292 mm) over-center clutch
Thermostat housing
Mechanical tach drive

OPTIONAL EQUIPMENT:

Alternators: 30 and 72 amp
Flywheels and flywheel housings
Injection pump for generator set governing (approx. 3-5%)
Auxiliary front pulley
Electronic tach drive

FIELD INSTALLED EQUIPMENT:

Air cleaners
Mufflers
Fans: Blower or suction
Radiator
PTO
Instrument panel
Tachometer and hourmeter
Cold weather starting aids

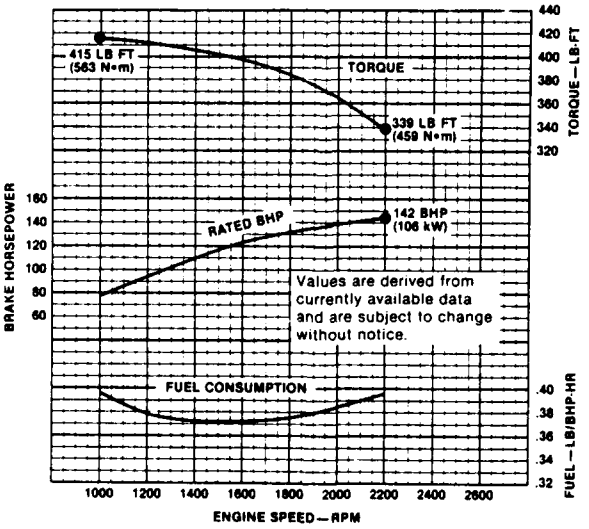
Rating Explanation

RATED BHP is the power rating for variable speed and load applications where full power is required intermittently.

FUEL CONSUMPTION CURVE shows fuel used in pounds per brake horsepower hour.

POWER OUTPUT guaranteed within 5% at standard ambient conditions and standard equipment.

For complete engine specifications for your particular requirements, see your distributor or authorized Detroit Diesel Allison representative.



Rating conditions of SAE: 77°F (25°C) and 29.31 in Hg (99 kPa) Barometer (Dry)

SPECIFICATIONS:

(Specifications and design subject to change without notice.)

Engine:

Bore/stroke ..... 4.19 in × 5.00 in (106 mm × 127 mm)
Number of cylinders 6
Piston displacement ..... 414 cu in (6.8 L)
Cycle 4
Rotation, facing flywheel end ..... Counterclockwise
Compression ratio 16.3:1
Firing order 1-5-3-6-2-4

Crankshaft:

Material ..... Forged steel; heat-treated, induction-hardened bearing surface
Type ..... Counterbalanced

Main bearings:

Number 7
Size ..... 3.12 in × 1.12 in (79.2 mm × 28.5 mm)
Material ..... Aluminum, high-strength-steel backed

Connecting rods:

Material ..... I-section, forged steel
Length ..... 7.99 in (203 mm)

Cylinder liners:

Material ..... Centrifugally-cast alloy iron
Type ..... Wet liner

Cylinder head:

Material ..... Cast iron

Piston pin:

Size ..... 1.62 in (41 mm)
Type ..... Full floating

Pistons:

Material ..... Aluminum alloy w/ring insert
Number of rings 3
Compression ..... 2 (Keystone top ring, rectangular second ring)
Oil 1

Valves:

Intake valve ..... Alloy steel
Exhaust valve ..... Alloy steel
Valve seats ..... Inserted (intake and exhaust)
Valve rotation ..... Yes (intake and exhaust)

Camshaft:

Material ..... Cast Proferal iron

Oiling system:

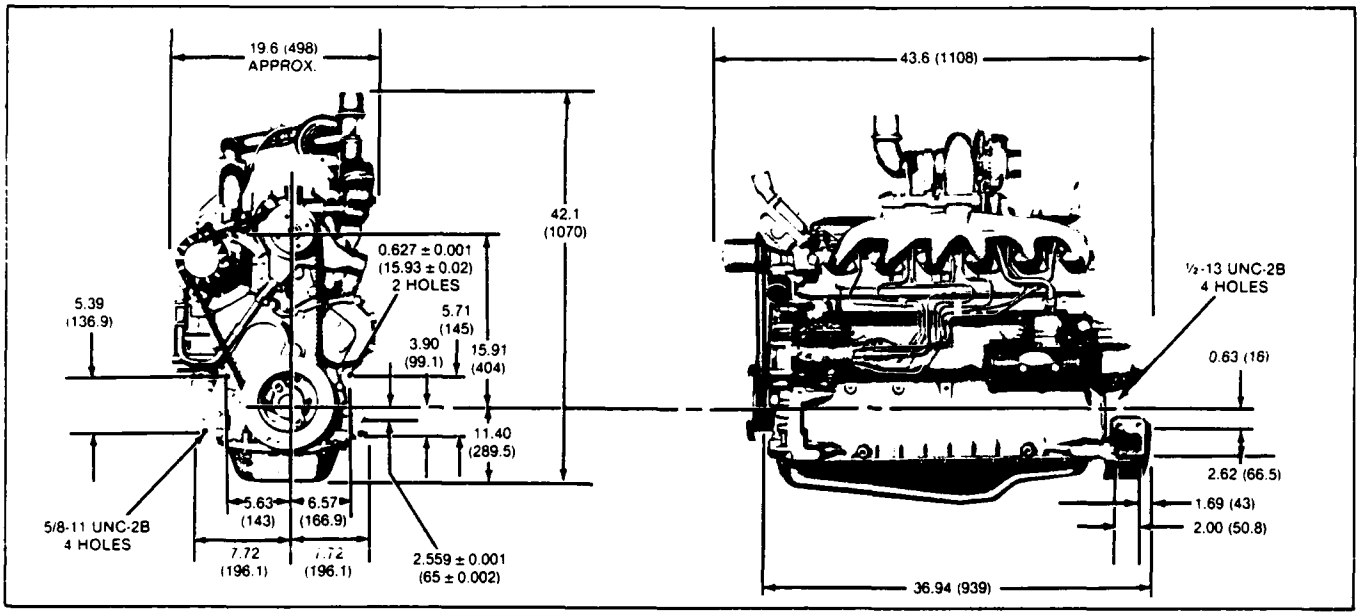
Pump type ..... Gear
Pump capacity ..... 16 gpm (60.5 liters/min)
Filters ..... Full-flow w/bypass; replaceable paper element
Crankcase capacity ..... 18 qt (17.1 liters)

Fuel system:

Injection pump ..... Distributor type
Nozzles ..... .374 in (9.5 mm) w/built-in filter
Fuel-transfer pump ..... Diaphragm-type
Fuel filters ..... Replaceable paper element

Cooling system:

Pump type ..... Centrifugal w/V-belt drive
Water flow to radiator ..... 57 gpm (216 liters/min)
Temperature control ..... Thermostat



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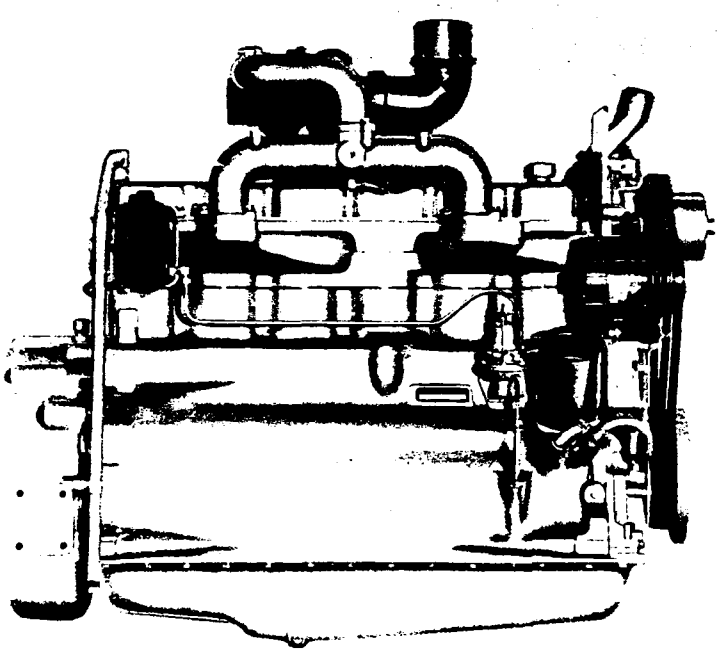
3SA223JD 2/86

Detroit Diesel Engines

INDUSTRIAL MODELS

Series 30
6359T
153 Hp



ENGINE DESCRIPTION: F063-9300

Type: 6-cylinder valve-in-head, turbocharged
Bore/stroke: 4.19 in x 4.33 in (106 mm x 110 mm)
Displacement: 359 cu in (5.9 L)
Basic weight (approx.): 1274 lb (579 kg)
Power: 153 hp (114 kW) @ 2500 rpm

FEATURES:

Heavy-duty, one-piece, gray-iron cylinder block with deep, thick-ribbed skirts.
Heat-treated, forged-steel crankshaft, dynamically balanced.
Forged-steel connecting rods with precision-machined square-tongue-and-grooves.
Centrifugally cast cylinder liners, wet-sleeve flanged design, individually replaceable.
Crankshaft-driven, positive gear-type lubricating pump.
Small-diameter nozzles with an exclusive edge-filter design.
Compact distributor-type injection pump, contains fuel filter, built-in transfer pump, temperature-compensating system, speed advance, and electric shut-off.
Oil spray piston cooling.

STANDARD EQUIPMENT:

Water and oil pumps
Oil pan
Engine oil cooler
Oil and fuel filters
Fuel-injection system complete (includes governor)
Intake and exhaust manifolds
Alternator: 12 volt, 63 amp w/regulator
Starter: 12 volt (no battery and cables)
Flywheel housing: SAE No. 3
Fuel-transfer pump
Thermostat housing
Lifter eyes
Flywheel: For 11.5 in (292 mm) over-center clutch

OPTIONAL EQUIPMENT:

Alternators: 72 amp
Flywheels and flywheel housings
Injection pump for generator set governing (approx. 3-5%)
Auxiliary front pulley

FIELD INSTALLED EQUIPMENT:

Air cleaners
Mufflers
Fans: Blower or suction
Radiator
PTO
Instrument panel
Tachometer and hourmeter
Cold weather starting aids

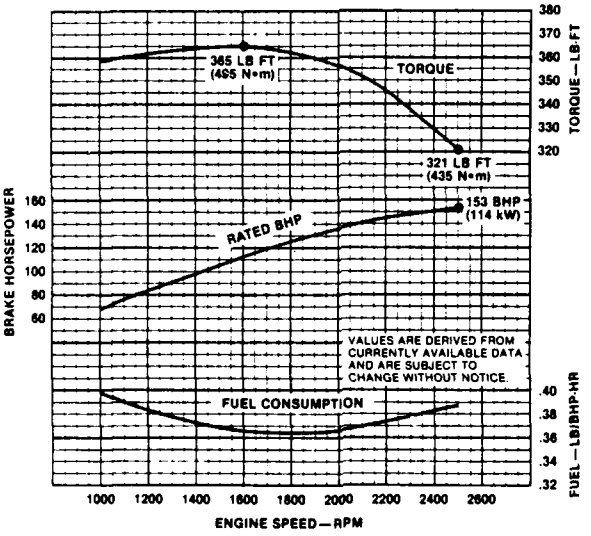
Rating Explanation

RATED BHP is the power rating for variable speed and load applications where full power is required intermittently.

FUEL CONSUMPTION CURVE shows fuel used in pounds per brake horsepower hour.

POWER OUTPUT guaranteed within 5% at standard ambient conditions and standard equipment.

For complete engine specifications for your particular requirements, see your distributor or authorized Detroit Diesel Allison representative.



Rating conditions of SAE: 77°F (25°C) and 29.31 in Hg (99 kPa) Barometer (Dry)

SPECIFICATIONS:

(Specifications and design subject to change without notice.)

Engine:

Bore/stroke ..... 4.19 in × 4.33 in (106 mm × 110 mm)
Number of cylinders 6
Piston displacement ..... 359 cu in (5.9 L)
Cycle 4
Rotation, facing flywheel end ..... Counterclockwise
Compression ratio 16.8:1
Firing order 1-5-3-6-2-4

Crankshaft:

Material ..... Forged steel; heat-treated, induction-hardened bearing surface
Type ..... Counterbalanced

Main bearings:

Number 7
Size ..... 3.12 in × 1.12 in (79.2 mm × 28.5 mm)
Material ..... Aluminum, high-strength-steel backed

Connecting rods:

Material ..... I-section, forged steel
Length ..... 7.13 in (181 mm)

Cylinder liners:

Material ..... Centrifugally-cast alloy iron
Type ..... Wet liner

Cylinder head:

Material ..... Cast iron

Piston pin:

Size ..... 1.62 in (41 mm)
Type ..... Full floating

Pistons:

Material ..... Aluminum alloy w/double ring insert
Number of rings 3
Compression ..... 2 (Keystone top ring, rectangular second ring)
Oil 1

Valves:

Intake valve ..... Alloy steel
Exhaust valve ..... Alloy steel
Valve seats ..... Inserted (intake and exhaust)
Valve rotation ..... Yes (intake and exhaust)

Camshaft:

Material ..... Cast Proferal iron

Oiling system:

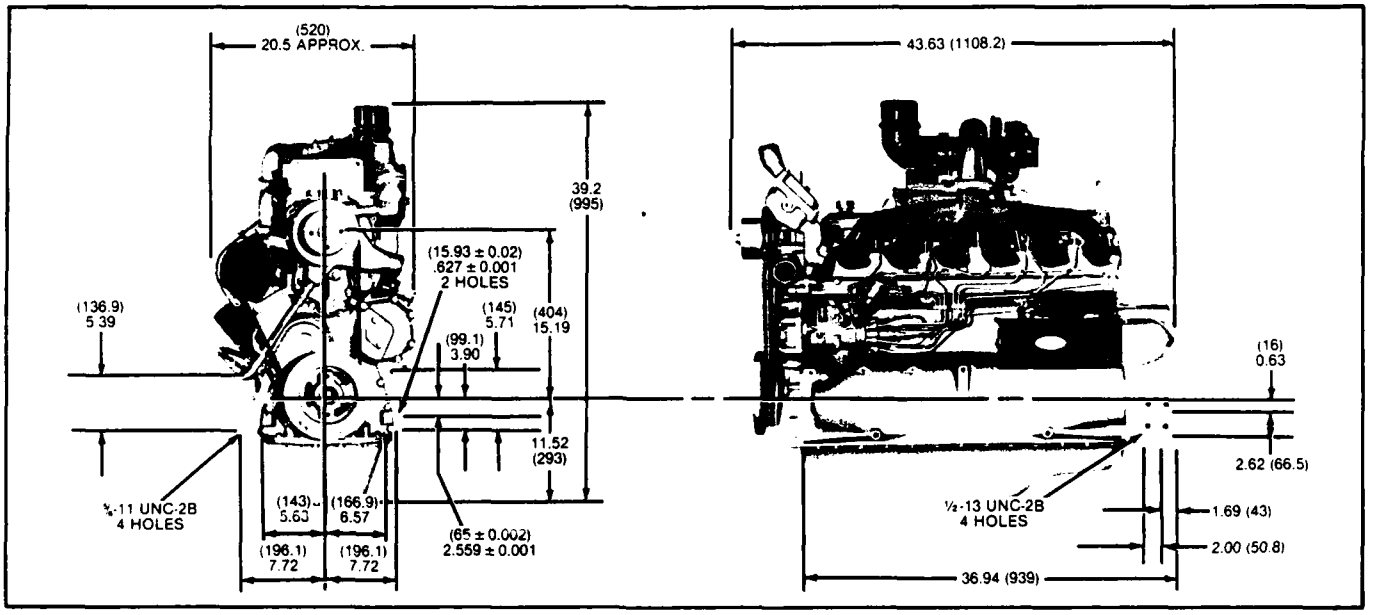
Pump type ..... Gear
Pump capacity ..... 16 gpm (60.5 liters/min)
Filters ..... Full-flow w/bypass; replaceable paper element
Crankcase capacity ..... 18 qt (17.1 liters)

Fuel system:

Injection pump ..... Distributor type
Nozzles ..... .374 in (9.5 mm) w/built-in filter
Fuel-transfer pump ..... Diaphragm-type
Fuel filters ..... Replaceable paper element

Cooling system:

Pump type ..... Centrifugal w/V-belt drive
Water flow to radiator ..... 56 gpm (212 liters/min)
Temperature control ..... Thermostat



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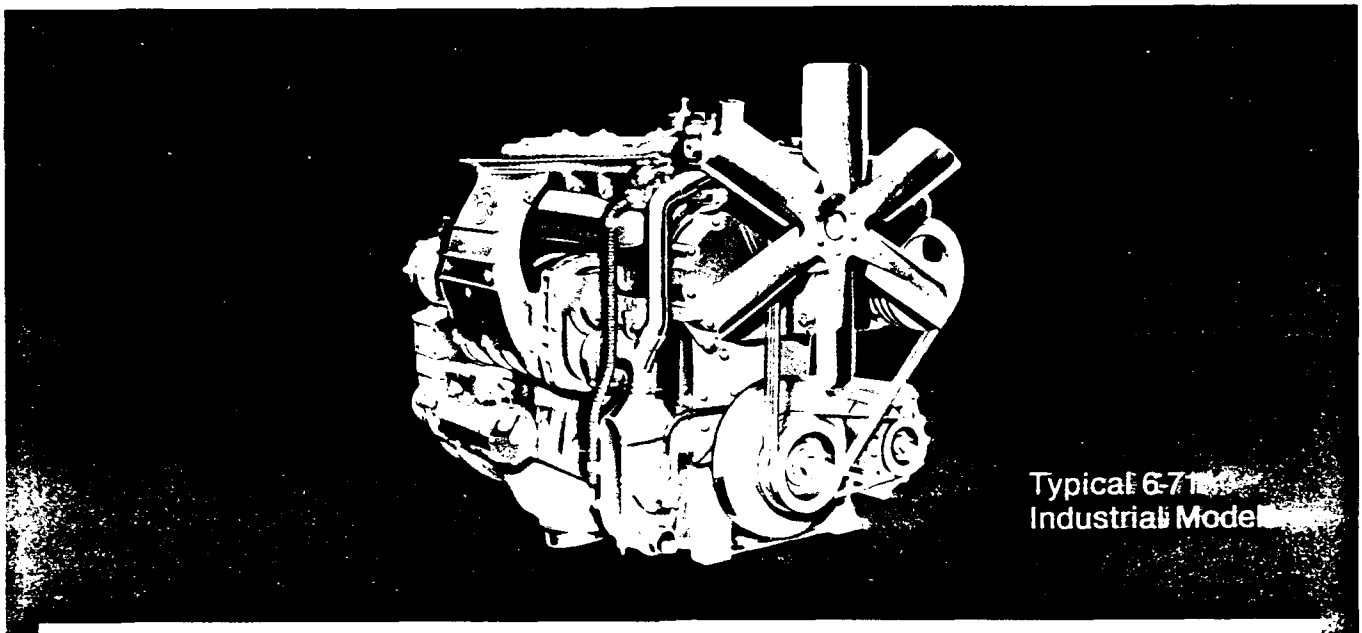
Detroit Diesel Engines

Industrial Models

4-71 155 hp

6-71 230 hp



Typical 6-71 Industrial Model

specifications

Basic Engine	4-71 N65 Injectors	6-71 N65 Injectors
Model	1043-5000, 1043-7000	1063-5000, 1063-7000
Description	Naturally Aspirated	Naturally Aspirated
Number of Cylinders	4	6
Bore and Stroke	4.25 in. × 5 in. (108 mm × 127 mm)	4.25 in. × 5 in. (108 mm × 127 mm)
Displacement	284 cu in. (4.66 liters)	426 cu in. (6.99 liters)
Rated Gross Power SAE J1995 (77°F, 25°C and 29.31 in. Hg, 99 kPa Barometer Dry)	155 BHP (116 kW) @ 2100 RPM	230 BHP (172 kW) @ 2100 RPM
Intermittent Gross Power SAE J1995 (77°F, 25°C and 29.31 in. Hg, 99 kPa Barometer Dry)	121 BHP (90 kW) @ 1800 RPM	180 BHP (134 kW) @ 1800 RPM
Torque SAE J1995 (77°F, 25°C and 29.31 in. Hg, 99 kPa Barometer Dry)	407 lb ft (552 N•m) @ 1600 RPM	609 lb ft (826 N•m) @ 1600 RPM
Compression Ratio	18.7 to 1	18.7 to 1
Approximate Dimensions Length Width Height Net Weight (Dry)	42 in. (1067 mm) 29 in. (737 mm) 42 in. (1067 mm) 1780 lbs (807 kg)	54 in. (1372 mm) 29 in. (737 mm) 39 in. (991 mm) 2190 lbs (933 kg)

For complete dimensional information, refer to installation drawing 2SA78 for Model 1043-5000, 2SA74 for Model 1043-7000, 2SA72 for Model 1063-5000 and 2SA71 for Model 1063-7000.

performance

Rating Explanation

RATED BHP is the power rating for variable speed and load applications where full power is required intermittently.

CONTINUOUS BHP is the power rating for applications operating under a constant load and speed for long periods of time.

FUEL CONSUMPTION CURVE shows fuel used in pounds per brake horsepower hour.

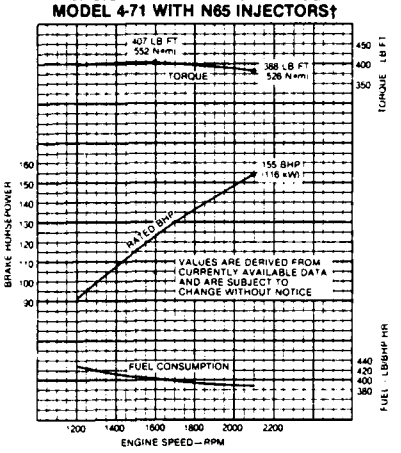
POWER OUTPUT guaranteed within 5% at standard ambient conditions.

THIS RATING does not include power requirements for accessory and standard equipment.

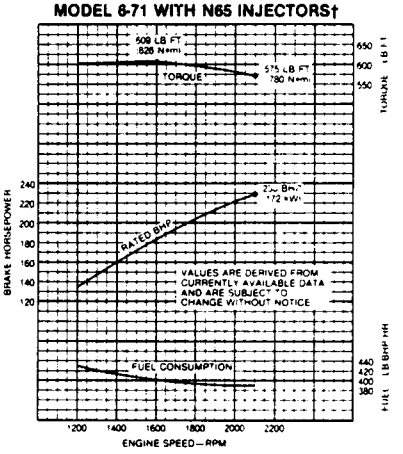
For complete engine specifications for your particular requirements, see your distributor or authorized Detroit Diesel Allison representative.

†Rating conditions of SAE: 77°F (25°C) and 29.31 in Hg (99 kPa) Barometer (Dry)

BASIC ENGINE PERFORMANCE MODEL 4-71 WITH N65 INJECTORS†



BASIC ENGINE PERFORMANCE MODEL 6-71 WITH N65 INJECTORS†



standard equipment

Air Inlet Housing

Alternator—12 volt, 42 amp

Crankshaft Pulley

Engine Mounts

Exhaust Manifold

Fan— 18 in, 6 blades, suction type, 4-71 only; 22 in, 6 blades, suction type, 6-71 only

Flywheel—SAE #1

Flywheel Housing—SAE #1

Fuel Filters—Spin on

Governor—Variable speed, with throttle controls

Injectors—Cam operated, unit type, clean tip

Instruments—Ammeter, oil pressure and water temperature gauges, and starter switch

Lube Oil Cooler

Lube Oil Filters—Full flow

Oil Pan—Cast iron pan for 16° inclination angle, 4-71 only; stamped steel pan for 20° inclination angle, 6-71

Starting Motor—12 volt

Vibration Damper—Single, heavy, viscous

For a complete listing of standard and optional equipment, consult your authorized Detroit Diesel Allison representative.

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Division of General Motors
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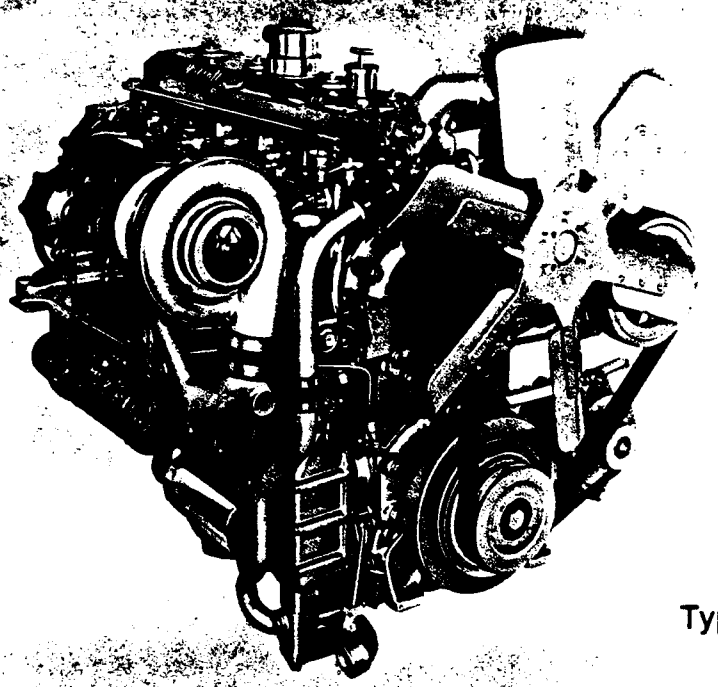
3SA177 10-85

Detroit Diesel Engines

INDUSTRIAL MODELS

4-71T 6-71T 6-71TA

SILVER 71



Typical 6-71TA

GENERAL SPECIFICATIONS

Basic Engine	4-71T	6-71T	6-71TA
Model	1043-7301	1063-8301	1063-8600
Number of Cylinders	4	6	6
Bore and Stroke	4.25 in × 5 in (108 mm × 127 mm)	4.25 in × 5 in (108 mm × 127 mm)	4.25 in × 5 in (108 mm × 127 mm)
Displacement	284 cu in (4.7 liters)	426 cu in (6.9 liters)	426 cu in (6.9 liters)
Compression Ratio	17 to 1	17 to 1	17 to 1
Lube Oil System Capacity•	Low—15 qts (14.2 liters) High—20 qts (18.9 liters)	Low—18 qts (17.0 liters) High—22 qts (20.8 liters)	Low—18 qts (17.0 liters) High—22 qts (20.8 liters)
Coolant Capacity (engine only)	14 qts (13.2 liters)	23 qts (21.8 liters)	23 qts (21.8 liters)
Length	44 in (1118 mm)	56 in (1421 mm)	56 in (1421 mm)
Width	31 in (787 mm)	32 in (813 mm)	32 in (813 mm)
Height	44 in (1118 mm)	52 in (1321 mm)	52 in (1321 mm)
Weight (dry)	1830 lbs (830 kg)	2195 lbs (996 kg)	2210 lbs (1002 kg)

•with standard oil pan

Approximate dimensions shown. For complete dimensional information, refer to installation drawing.
For complete coolant specifications, see publication 7SE298. For complete fuel and lubricating oil specifications, see publication 7SE270.

HORSEPOWER VERSATILITY

Basic Engine	4-71T	6-71T	6-71TA
Injector	7E75	N80	N80
Rated Gross Power	200 BHP (149 kW) @ 2100 RPM	290 BHP (216 kW) @ 2100 RPM	300 BHP (224 kW) @ 2100 RPM
Peak Torque	533 lb ft (723 N•m) @ 1400 RPM	817 lb ft (1108 N•m) @ 1000 RPM	825 lb ft (1119 N•m) @ 1200 RPM
Injector	N70	7C75	7C75
Rated Gross Power	185 BHP (138 kW) @ 2100 RPM	280 BHP (209 kW) @ 2100 RPM	285 BHP (213 kW) @ 2100 RPM
Peak Torque	500 lb ft (678 N•m) @ 1400 RPM	785 lb ft (1064 N•m) @ 1000 RPM	777 lb ft (1053 N•m) @ 1400 RPM
Injector	7N65	N70	N70
Rated Gross Power	170 BHP (127 kW) @ 2100 RPM	260 BHP (194 kW) @ 2100 RPM	265 BHP (198 kW) @ 2100 RPM
Peak Torque	469 lb ft (636 N•m) @ 1400 RPM	747 lb ft (1013 N•m) @ 1000 RPM	738 lb ft (1001 N•m) @ 1200 RPM
(Continuous Rating)			
Injector	7N65	7N65	7N65
Rated Gross Power	144 BHP (107 kW) @ 1800 RPM	213 BHP (159 kW) @ 1800 RPM	216 BHP (161 kW) @ 1800 RPM

Rating conditions of SAE: 77°F (25°C) and 29.31 in Hg (99 kPa) Barometer (Dry)
These ratings are subject to change without notice or obligation.

EQUIPMENT SPECIFICATIONS

Aftercooler—6-71TA only

Alternator—12 volt, 42 amps

Blower—With bypass valve - 6-71T & TA only

Camshaft—Drop forged with induction hardened polished lobes

Connecting Rod—Rifle drilled, drop forging

Crankshaft—Drop forged, dynamically and statically balanced, induction hardened journals and fillets

Crankshaft Pulley

Cylinder Block—Cast iron alloy replaceable cylinder liners

Cylinder Head—Cast iron alloy, 4 exhaust valves per cylinder, replaceable valve seats

Engine Lifter Brackets

Fan—Suction

Flywheel—SAE #1, #2 or #3 depending on engine

Flywheel Housing—SAE #1, #2 or #3

Fuel Filters—Spin-on type, includes both primary and secondary filter

Governor—Variable speed

Injectors—Cam operated, unit type, clean tip

Lube Oil Cooler—Thermatic plate type cooler, stainless steel

Lube Oil Filter—Spin-on, full-flow, no bypass filter required

Oil Pan—16°, 20° or 30° depending on engine

Piston—Crosshead design, cast iron alloy

Starting Motor—12 volt with sprag overrunning clutch

Turbocharger—Improved design, high efficiency model TV63, .96 A/R, 4-71T; 54H-005, .99 A/R, 6-71T & TA

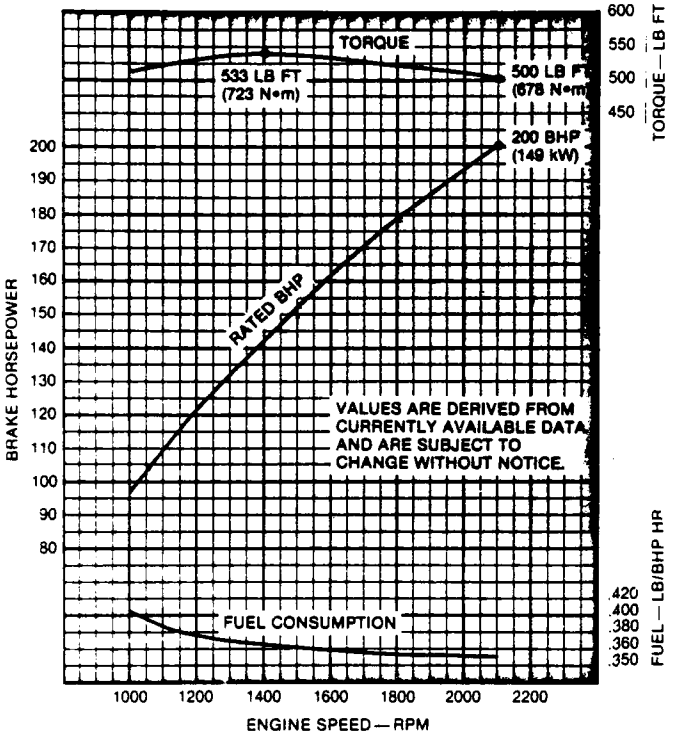
Vibration Damper—Single, viscous

Water Pump—Impeller type with ceramic seal

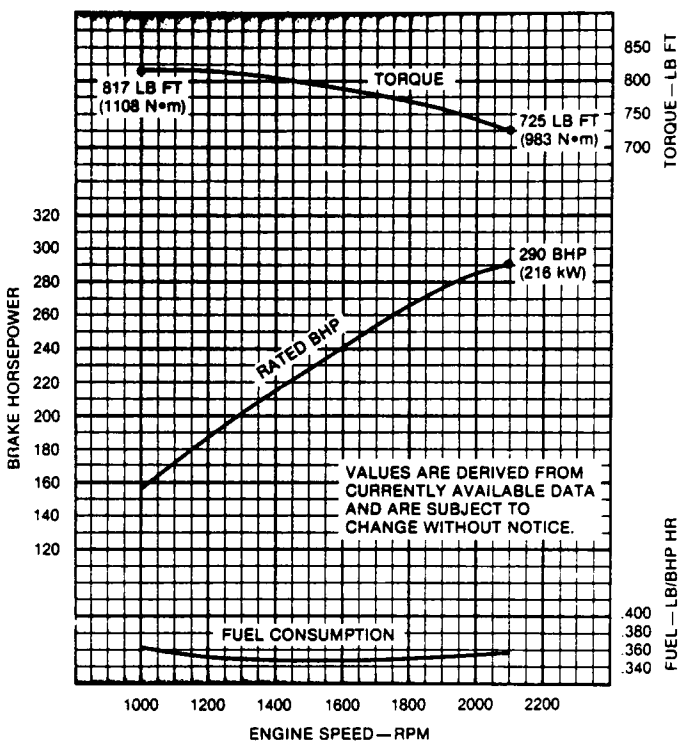
Additional options are also available for most of these items. For a complete listing of standard and optional equipment, consult your authorized Detroit Diesel Allison representative.

PERFORMANCE CURVES

BASIC ENGINE PERFORMANCE MODEL 4-71T WITH 7E75 INJECTORS†



BASIC ENGINE PERFORMANCE MODEL 6-71T WITH N80 INJECTORS†



Rating Explanation

RATED BHP is the power rating for variable speed and load applications where full power is required intermittently.

FUEL CONSUMPTION CURVE shows fuel used in pounds per brake horsepower hour.

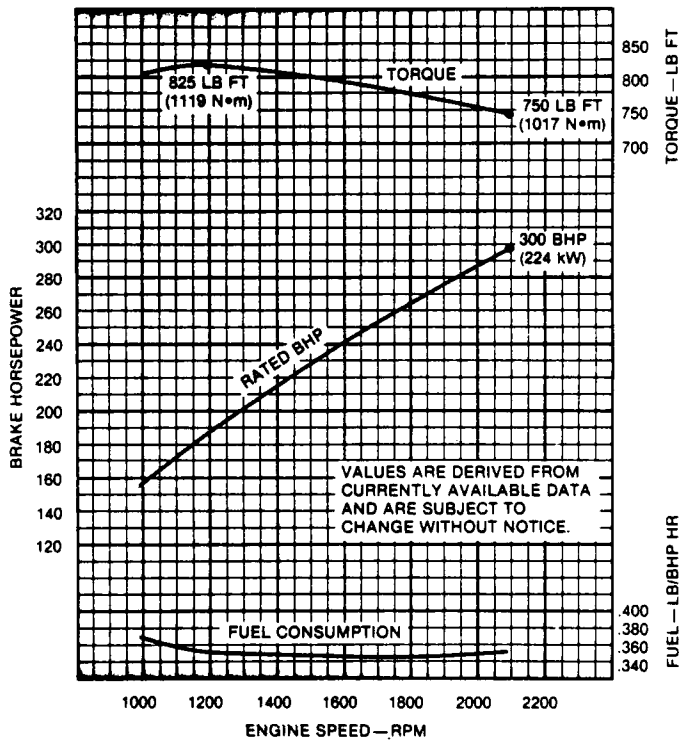
POWER OUTPUT guaranteed within 5% at standard ambient conditions.

THIS RATING does not include power requirements for accessory and standard equipment. For complete engine specifications for your particular requirements, see your distributor or authorized Detroit Diesel Allison representative.

†Rating conditions of SAE: 77 °F (25 °C) and 29.31 in Hg (99 kPa) Barometer (Dry)

SILVER 71

BASIC ENGINE PERFORMANCE MODEL 6-71TA WITH N80 INJECTORS†



DESIGN FEATURES AND BENEFITS

Unit Injector Fuel System
The main components of this system are the simple and efficient Needle Valve Injectors that precisely meter the fuel individually to each cylinder.

The injector creates the high pressure needed for efficient combustion . . . meters and injects the fuel in the exact amount required at the correct time . . . and atomizes it for proper burning with the air in the combustion chamber.

The injectors in the Silver 71 engines aid combustion efficiency with modified plunger and bushing timing and improved spray tips.

Centrifugally Cast Liners
Closely controlled metallurgical and heat treatment specifications allow for precise machining. Liner working surfaces are processed to insure proper piston ring lubrication. Our heat treating method assures the liner has proper strength and geometry that promotes long piston and liner life.

In addition, the height and shape of the liner ports have been modified for optimum air inlet timing and maximum air swirl in the combustion chamber in conjunction with the newly timed camshaft.

Crosshead Piston
A key durability improvement is the use of crosshead pistons in all Silver 71 engines. This patented design features separate crown and skirt components that work independently of each other: the crown absorbs combustion forces while the skirt absorbs thrust loads. Proven in larger Detroit Diesel engines, crosshead pistons extend ring life and reduce cylinder bore wear.

New Piston Ring Designs
New, longer-wearing compression rings feature barrel-faced grooveless compression rings with hard molybdenum coating replacing conventional chrome rings. This new design extends ring life from 30-50%. The new rings reduce friction, thereby helping to improve fuel economy. Reduced oil consumption is an additional benefit.

Air Induction System
The Silver 71 air induction system, which incorporates a blower bypass valve and passage, reduces pumping losses and provides a savings of up to 7 horsepower. The design is essentially a spring loaded poppet type bypass valve in the blower end plate. At suitable engine speed and load, the valve opens, allowing air box pressure to equalize with blower inlet pressure, thus reducing pumping horsepower requirements. This optimizes thermal efficiency through improved air-fuel ratio control.

High-Efficiency Turbocharger
Silver 71 engines feature a new, more efficient family of turbochargers that more closely meet the air delivery requirements of the specific engine and its application. This improvement aids combustion efficiency, fuel economy, smoke control, and engine response.

Parts Interchangeability
Silver 71 engines offer up to 70% moving parts interchangeability. In addition, much of the external, optional equipment, such as starting systems, air compressors, and alternators, are also interchangeable throughout the Series. Your current engine can also be upgraded to Silver without major investment. As an owner you benefit four ways: 1) Reduced Parts Inventory, 2) Low Parts Cost, 3) Good Parts Availability, 4) Ease of Service.

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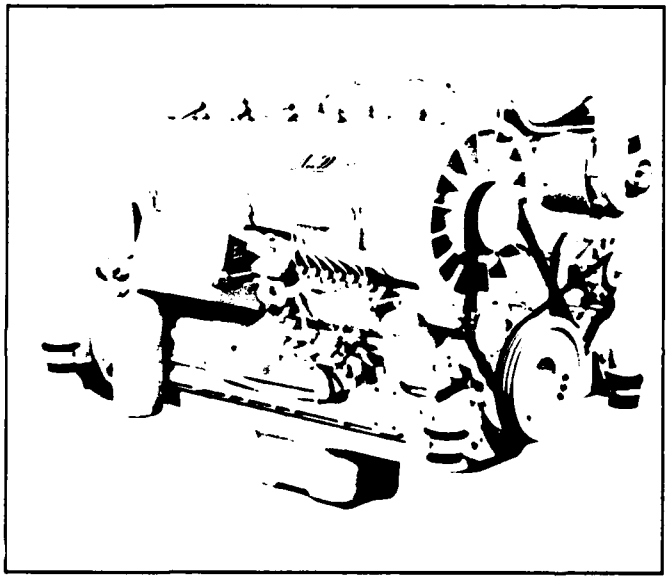
3SA203 4-85 Information and specifications subject to change without notice or obligation. Litho in U.S.A.

BF6L913
Specification Data

KHD DEUTZ



Engine Type	6-cylinder turbocharged four cycle air-cooled diesel, direct injected
Bore/Stroke	4/4.9 in. (102/125 mm)
Displacement	374 in.^{3} (6.12 L)
Compression Ratio	15.5:1
Maximum Output DIN 6271	160 HP @ 2800 RPM (118 KW @ 2800 RPM)
Maximum Torque DIN 6271	361 lbs. ft. @ 1650 RPM (490 NM @ 1650 RPM)
Min. Idling Speed	650-700 RPM
Specific Fuel Consumption at Max. Torque	.364 lbs./HPh (225 g/KWh)
Rotation	counterclockwise (view toward flywheel)
Net Weight	1133 lbs. (515 Kg)

DEUTZ AIR-COOLED DIESEL ENGINES FOR ECONOMICAL PERFORMANCE

RELIABILITY
No matter how harsh the environment, Deutz Air-Diesels provide dependable power. Air-cooling *eliminates radiators*, water pumps, hoses, coolant, and additives that together account for more than 40% of the unscheduled downtime of liquid-cooled engines.

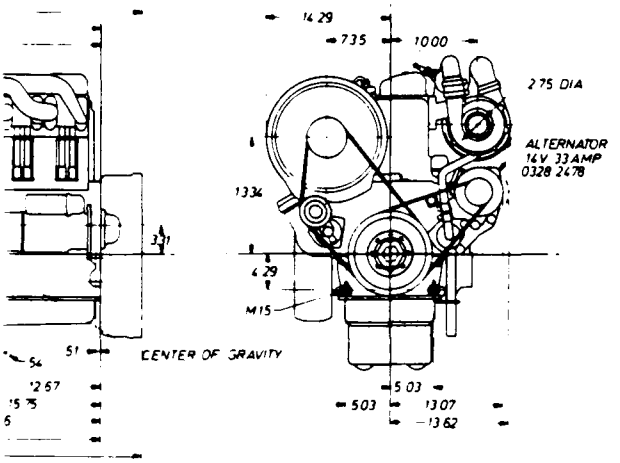
FUEL ECONOMY
Advanced combustion chamber design, precise fuel injection, low friction losses of moving parts, and reduced power requirements for cooling make Deutz AirDiesels the leader in fuel economy.

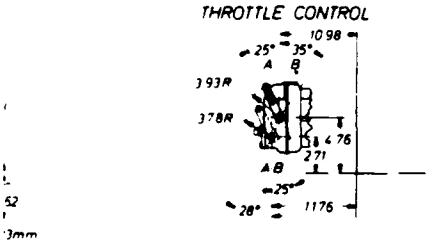
EASY TO MAINTAIN
Deutz modular design cylinder units can be serviced individually and parts are interchangeable within engine series, thereby reducing inventory and service costs.

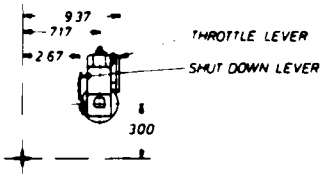
LONG LIFE
Years of research, development and testing are a basic part of every Deutz engine family. Advanced metalurgy, precision manufacturing practices and strict adherence to quality control and assembly procedures assure Deutz engines will keep running for you tomorrow.

SERVICE SUPPORT
A factory trained distributor/dealer network provides comprehensive engine service and parts availability throughout North America. Worldwide, Deutz engines are serviced in over 130 countries.

KHD DEUTZ







POS	THROTTLE LEVER	SHUT DOWN LEVER
A	IDLE	START
B	FULL LOAD	SHUT DOWN

dimensions are in inches unless otherwise indicated.

BASIC ENGINE

Cooling air blower, turbocharger (front), double V-belt drive, lube oil pump, lube oil filter, lube oil cooler, oil pan, injection pump with governor, speed control with shutdown levers, fuel pump, fuel filter, crankcase breather, angle drive for tachometer/hourmeter, air intake manifold, exhaust manifold, exhaust elbow at turbocharger outlet, exhaust elbow flange, oil pressure switch with indicator light, grey finish coating, instruction and spare parts manual.

OPTIONAL EQUIPMENT

Electric starters, alternator, muffler, flywheels, flywheel housings, engine mounting feet, oil bath air cleaner with precleaner, V-belt guard, torque converter oil cooler, gauges, instrument panels, hydraulic pumps, starting aids, PTO pulleys, automatic shutdown devices, tool kit.

FEATURES

Cylinders - finned cylinders separately removable.

Cylinder heads - alloy individual cylinder heads.

Crankshaft - hardened forged steel.

Camshaft drive - by crankshaft through helical tooth spur gear at blower end.

Crankcase Material - grey cast iron.

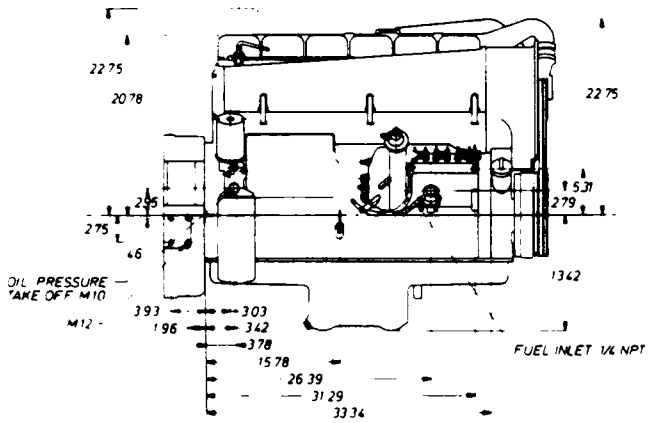
Pistons - aluminum three ring pistons.

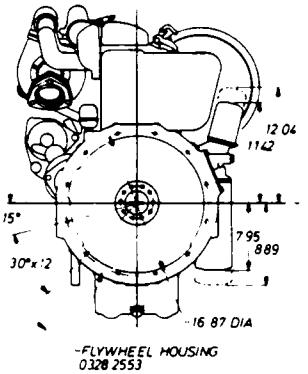
Injection pump - gear driven Bosch in-line injection pump.

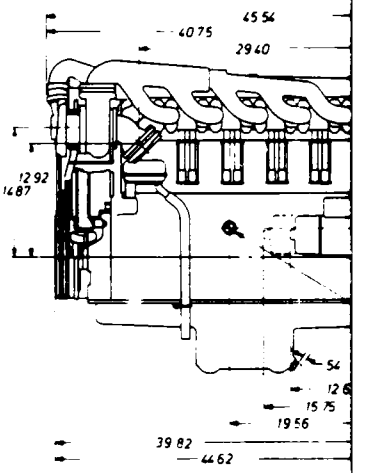
Cooling system - direct cylinder cooling by axial cooling blower.

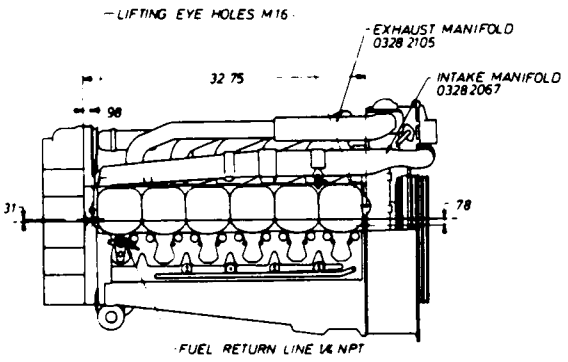
BF6L913

Specification Data

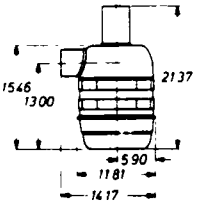




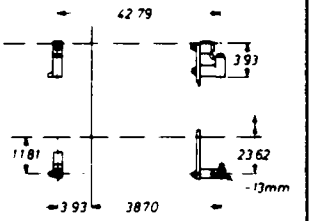




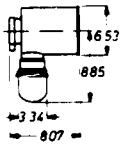
OIL BATH AIRCLEANER 0328 2649



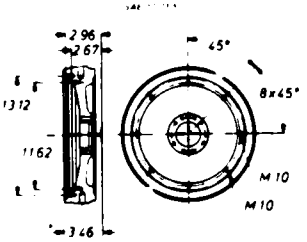
RIGID MOUNTS 0328 2561



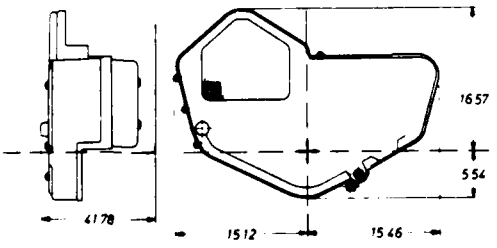
PRECLEANER 0328 2635



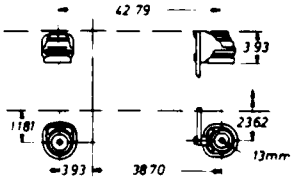
FLYWHEEL 0328 2513



V-BELT GUARD 0328 2579



FLEX MOUNTS 0328 2569



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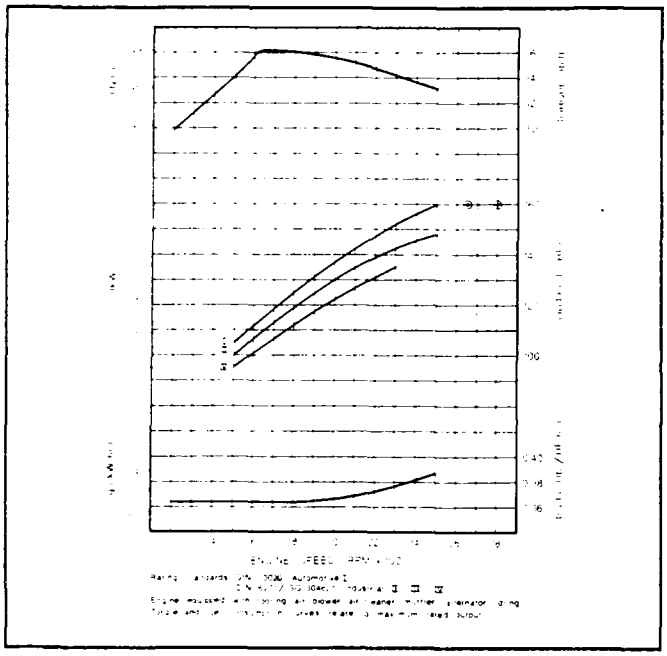


DIN 6271 RATING OUTPUT DATA
II Light Duty Intermittent Output
III Heavy Duty Intermittent Output
IV Continuous Duty Output

DIN 6271 REFERENCE CONDITIONS
80.6°F (27°C) Temperature
400' (120m) Altitude
60% Humidity

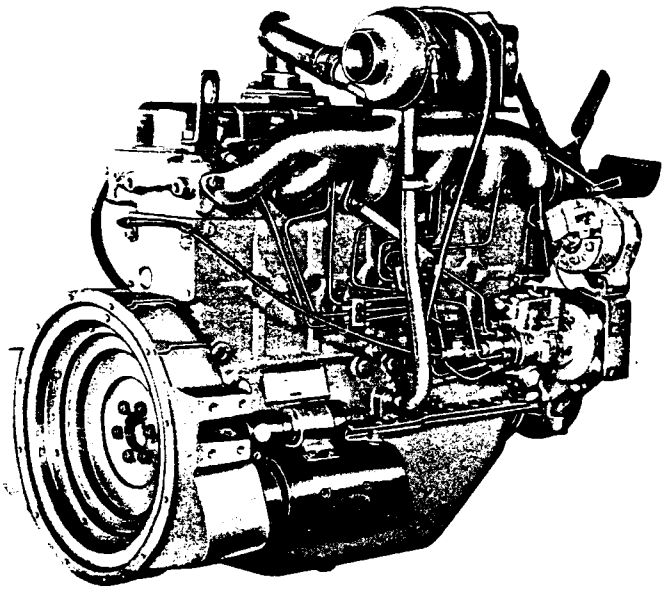
AIRDIESEL

Engine Speed	RPM	1500	1800	2000	2150	2300	2500	2650	2800
II Light Duty Intermittent Output to DIN 6271	HP KW	105 77	125 92	137 101	144 106	152 112	160 118	160 118	160 118
III Heavy Duty Intermittent Output to DIN 6271	HP KW	100 74	119 88	130 96	136 100	142 104	148 109	— —	— —
IV Continuous Duty Output to DIN 6271	HP KW	95 70	112 82	122 90	130 96	135 99	— —	— —	— —

999-7108

Printed in USA

Model D-3400-T
6 Cylinder Turbocharger
DIESEL ENGINE



STANDARD EQUIPMENT

Fuel pump — horizontal type integral with governor including 12-volt solenoid (ETR)
Governor — mechanical, manually controlled variable speed
Turbocharger
Oil cooler
Water pump — 15" from C/L crankshaft
Fuel filter — mounted spin-on type
Oil filter — mounted spin-on 12 GPM full flow type
Alternator — 12 volt, 37 amp (negative ground)
Starter — 12 volt with solenoid
Pad type SAE #3 bellhousing and flywheel — for 10" clutch
Fan — 20" - 5 blade suction
Auxiliary fuel transfer pump
Vibration dampner

OPTIONAL ACCESSORIES

SAE #3 flywheel for any standard make U.S. clutch
SAE #2 or #4 bellhousing and flywheel for any standard make U.S. clutch
Tach drive — mechanical type (engine speed or ½ engine speed — 7/8-18, 0.161 or 0.191 tang drive)
Idler assembly in lieu of alternator
2 or 3 vee crankshaft pulley
Fan — 20" - 5 blade blower
Water separator (spin on - with drain cock)
24 volt electrical equipment
Fixed speed governor

SPECIFICATIONS

Cu. In. displacement	339
Bore and stroke	4"x4½"
Number of cylinders	6
Firing order	1-5-3-6-2-4
Compression ratio	16:1
Length (fan to rear face bellhousing	41.06"
Height (bottom oil pan to C/L turbocharger)	33.12"
Width	23.24"

CAPACITIES

Water — head and block (U.S. qts.)	12.5
Oil pan — Qts. (U.S. std. — includes 1 qt. for oil filter)	8
Max tipping angle (continuous) oil	15°

WEIGHT

Fan thru flywheel	1025 lbs.

INSTALLATION DRAWING

Fan thru flywheel — 40-A-8984

NOTE: White Engines, Inc. reserves the right to change design or specifications without notice.

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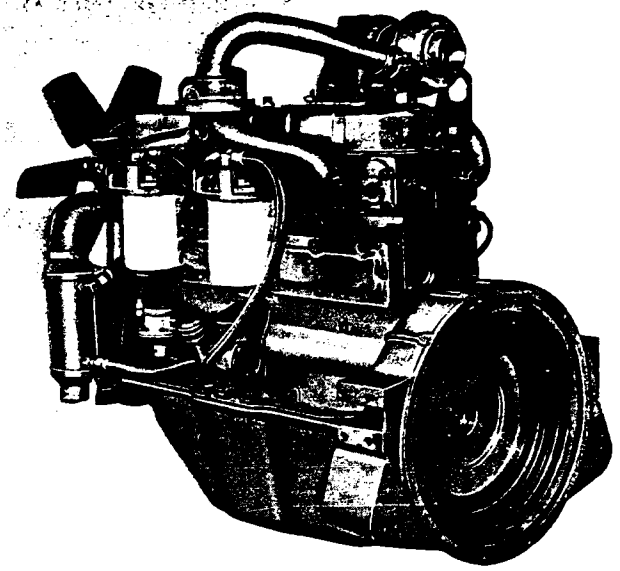
MAKERS OF HERCULES ENGINES SINCE 1915

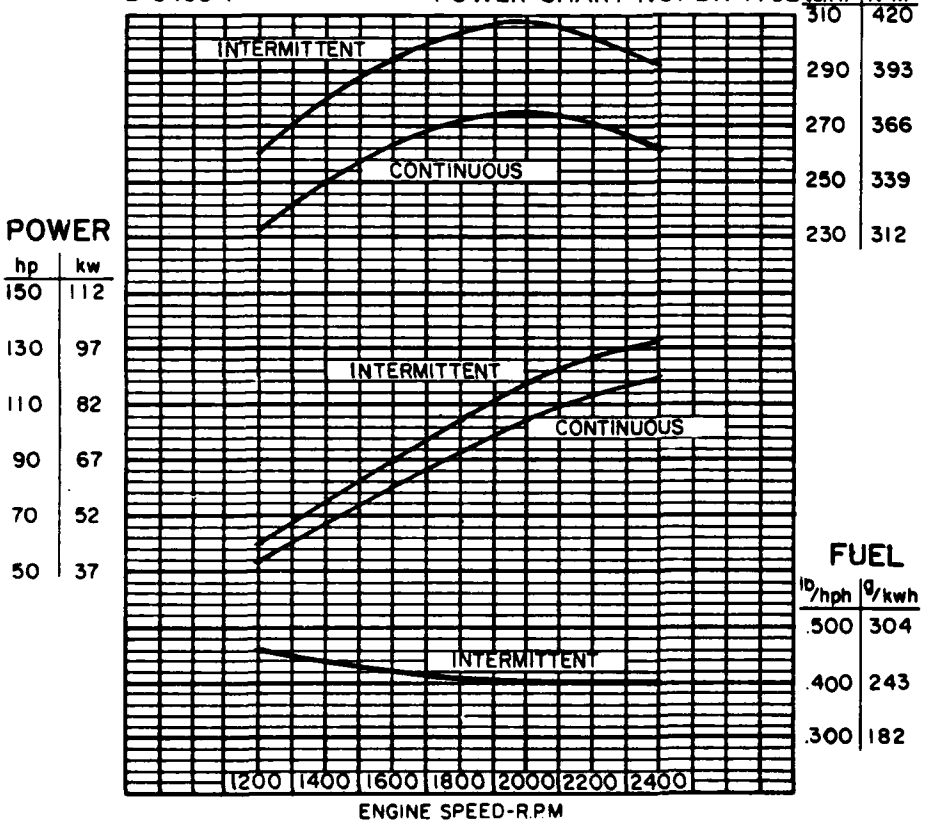
D3400-T 6 CYLINDER TURBOCHARGER DIESEL ENGINE



NOTE:

1. Data based on SAE J1349.
   Does not include fan or any power absorbing accessories.
2. Altitude correction:
   Deduct 2% per 1000 ft. (304.8m) above 500 ft. (152.4m) for intermit tent operation.
   Deduct 2% per 1000 ft. (304.8m) above 5500 ft. (1676.4m) for continuous operation.
3. Temperature correction:
   Deduct 1% per 10° (5.6°C) above 77° (25.0°C).

D-3400-T POWER CHART NO. DX-1752



POWER hp	kw
150	112
130	97
110	82
90	67
70	52
50	37

TORQUE lb.ft.	N-m
310	420
290	393
270	366
250	339
230	312

FUEL lb/hph	g/kwh
.500	304
.400	243
.300	182

INTERMITTENT HORSEPOWER: The power available for intermittent operation at varying speed. Continuous (long term) operation at these conditions is not recommended.

CONTINUOUS HORSEPOWER: The power available for continuous operation at rated speed.

WHITE
ENGINES, INC.

P O BOX 6904
CANTON, OHIO 44706
PHONE (216) 454-5631
TELEX-98-3439 WHTENGS CTN

September 26, 1985

Mr. Bob Braun
KURZ & ROOT CO.
1000 N. Meade
Appleton, WI 54911

Dear Bob:

Please find enclosed a torsional analysis of the D-3400-T as discussed during your visit in August. This is the engine proposed for the 60 KW D.O.D. generator you are currently producing.

As this program moves along, we would want to conduct a actual analysis at your facility.

I understand your proposal to the government has been well received.

If there is anything I can do to assist in your program, don't hesitate to call.

Sincerely,

WHITE ENGINES, INC.

Gary W. Kandel

GWK:jmc
Enclosure

cc: R. J. Holtgreive

ATTACHMENT 3

Copies to:	WHITE ENGINES, INC.	Page 1 of 4
E. Caruso R. Petersen G. Kandel Engr. File	ENGINEERING REPORT	Date: 9-9-85
	Subject: TORSIONAL ANALYSIS OF A D-3400-T DRIVING A 60 KW LIMA GENERATOR (DOD PACKAGE)	S/N: D-3400-T-85-51 By: S. TULI/jc Attachment

REF.: LIMA GENERATOR DATA SHEET - ATTACHED.

OBJECT:

To evaluate the torsional natural frequency and identify the major orders of excitation of a D3400X290 driving a 60 KW Lima generator per attachment.

CONCLUSION:

1. Mathematical analysis indicates the first node-mode natural frequency of the subject engine/generator combination is 191.5 cps. This natural frequency can be excited by 6th order at 1,915 RPM, and 9th order at 1,277 RPM.

2. Mathematical analysis indicates the second node-mode natural frequency of the subject engine/generator combination is 214.5 cps. This natural frequency can be excited by 6th order at 2,145 RPM, and 9th order at 1,430 RPM.

3. Page 2 shows the normal elastic curve for one and two node vibration and the approximate location of the nodal points where maximum stresses occur.

4. Maximum torsional stress due to first node-mode vibration is in the generator shaft and is 12,005.16 psi/1° amp. Maximum torsional stress due to second node-mode vibration occurs near the 5th/6th crankpin and is 10,388.27 psi/1° amp. These figures can be used to determine the maximum torsional stress once the resonant amplitudes are known.

RECOMMENDATION:

Conduct a torsional survey to establish resonant amplitudes of the engine/generator combination. Depending on the correlation achieved, the measured first & second node-mode amplitudes can be used to predict shaft stress.

DISCUSSION:

Six-cylinder, four-cycle engines have the 3, 6, 9, 12 etc. orders as major orders. Any other orders that fall within the operating range of the set are not major orders, and should not induce large double amplitudes. It is recommended that torsiographs be taken to establish the resonant amplitudes and suitability of this combination. Once the amplitude is known for each mode of vibration, the appropriate Holzer table can be used to establish the torque and stress in the sections of interest.

ATTACHMENT 2

MASS ELASTIC SYSTEM

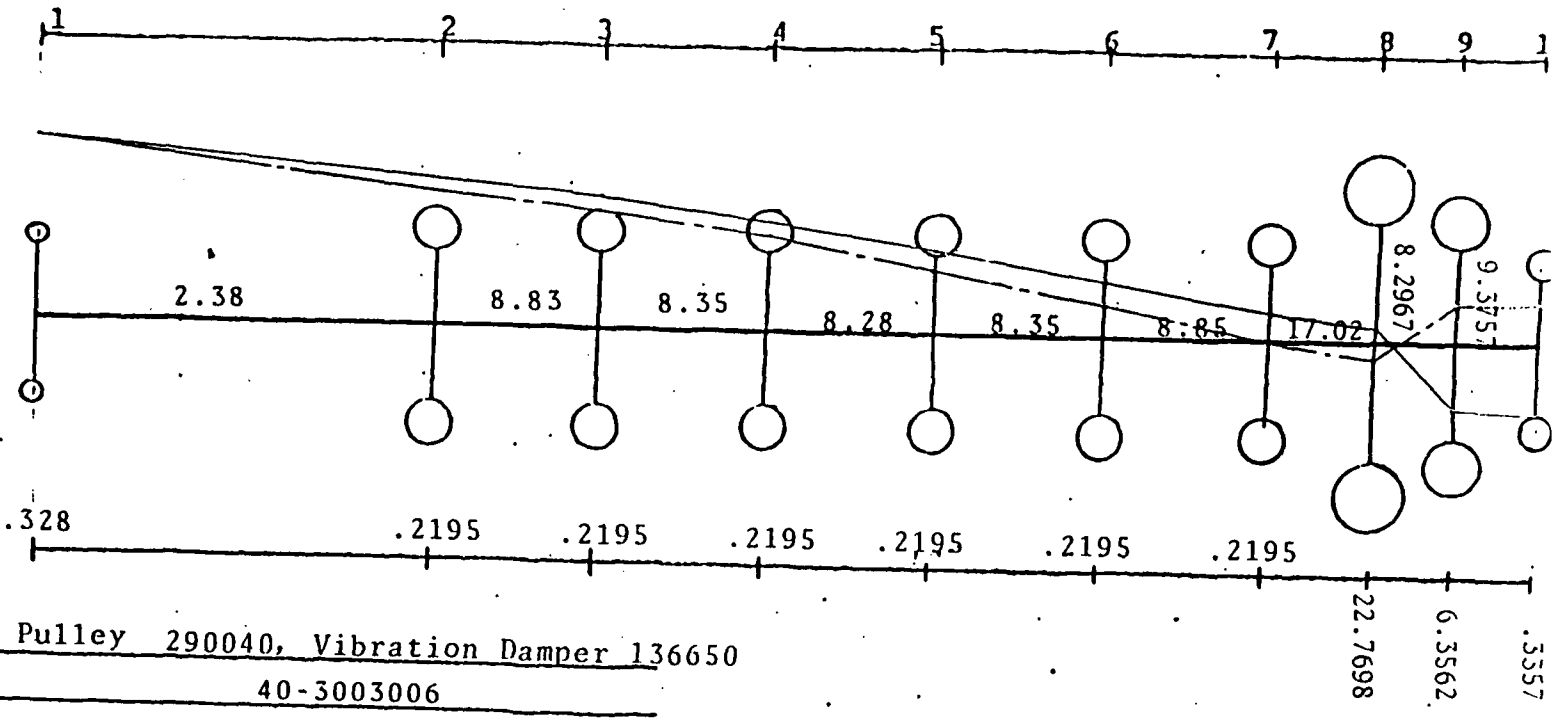
WHITE ENGINE MODEL D-3400-T

SPEC. NO. D3400X290

ITEMS:

STIFFNESS: $\frac{C}{10^6}$ in-lb/rad

MASSES: J in-lb-sec^2



ITEM: 1 Crankshaft Pulley 290040, Vibration Damper 136650

2-7 Crankshaft 40-3003006

Connecting Rod 288197

Piston & Pin Assembly 40-3010454

Rings 40-3010501, 40-3010503, 40-3010504

8 Flywheel 508993 w/Ring Gear 8291

Hub, Fan & Disc Assembly

9 Main Rotor & Generator Shaft

10 Exciter Rotor & Rectifier Assembly

WHITE ENGINES, INC.

WHITE ENGINES, INC.

MODEL D-3400-T

SPEC. NO. D3400X290

HOLZER TABLE

1ST NODE-MODE

Item	J in-lb-sec^2	$\frac{J\omega^2}{10^6}$	A Radian	$\frac{J\omega^2 A}{10^6}$	$\sum \frac{J\omega^2 A}{10^6}$	$\frac{C}{10^6}$ in-lb/rad	$\frac{\sum J\omega^2 A}{C}$
1	.328	.4749	1.0000	.4749	.4749	2.38	.1995
2	.2195	.3178	.8005	.2544	.7293	8.83	.0826
3	.2195	.3178	.7179	.2281	.9574	8.35	.1147
4	.2195	.3178	.6032	.1917	1.1491	8.28	.1388
5	.2195	.3178	.4644	.1476	1.2967	8.35	.1553
6	.2195	.3178	.3091	.0982	1.3949	8.85	.1576
7	.2195	.3178	.1515	.0481	1.4430	17.02	.0848
8	22.7698	32.9653	.0667	2.1988	3.6418	8.2967	.4389
9	6.3562	9.2023	-.3722	-3.4251	.2167	9.3757	.0231
10	.3357	.4860	-.3953	-.1921	.0246		

Frequency = 191.5 cps.

$\omega^2 = (2\pi F)^2$

$\omega^2 = 1.447762 \times 10^6$ sec.$^{-2}$

STRESSES: PSI/°1 Amplitude

	d	d^2	T .IN-LB-RAD	$\tau = \frac{T}{57.3} \cdot \frac{5.1}{d^2} \cdot c_1$ PSI AMP
6th Crank pin	2.374	13.3796	1.4430×10^6	9,599.30
Generator Shaft	3.00	27.00	3.6418×10^6	12,005.16

WHITE ENGINES, INC.

MODEL D-3400-T

SPEC. NO. D3400X290

HOLZER TABLE

2ND NODE-MODE

Item	J in-lb-sec^2	$\frac{J\omega^2}{10^6}$	A Radian	$\frac{J\omega^2 A}{10^6}$	$\sum \frac{J\omega^2 A}{10^6}$	$\frac{C}{10^6}$ in-lb/rad	$\sum \frac{J\omega^2 A}{C}$
1	.328	.5958	1.0000	.5958	.5958	2.38	.2503
2	.2195	.3987	.7497	.2989	.8947	8.83	.1013
3	.2195	.3987	.6484	.2585	1.1532	8.35	.1381
4	.2195	.3987	.5103	.2035	1.3567	8.28	.1638
5	.2195	.3987	.3465	.1381	1.4948	8.35	.1790
6	.2195	.3987	.1675	.0668	1.5616	8.85	.1764
7	.2195	.3987	-.0089	-.0035	1.5581	17.02	.0915
8	22.7698	41.3593	-.1004	-4.1525	-2.5944	8.2967	-.3127
9	6.3562	11.5455	.2123	2.4511	-.1433	9.3757	-.0153
10	.3357	.6098	.2276	.1388	-.0045		

Frequency = 214.5 cps.
$\omega^2 = (2\pi F)^2$
$\omega^2 = 1.816412 \times 10^6$ sec.$^{-2}$

STRESSES: PSI/°1 Amplitude				
	d	d^3	T .IN-LB-RAD	$\tau = \frac{T}{57.3} \cdot \frac{5.1}{d^3} \cdot \frac{PSI}{^\circ 1 \text{ AMP}}$
5th/6th Crank pin	2.374	13.3796	1.5616×10^6	10,388.27
Generator Shaft	3.00	27.00	2.5944×10^6	8,552.41

DRIPPROOF A. C. GENERATOR

SINGLE BEARING 360 FRAME

TORSIONAL ANALYSIS DATA

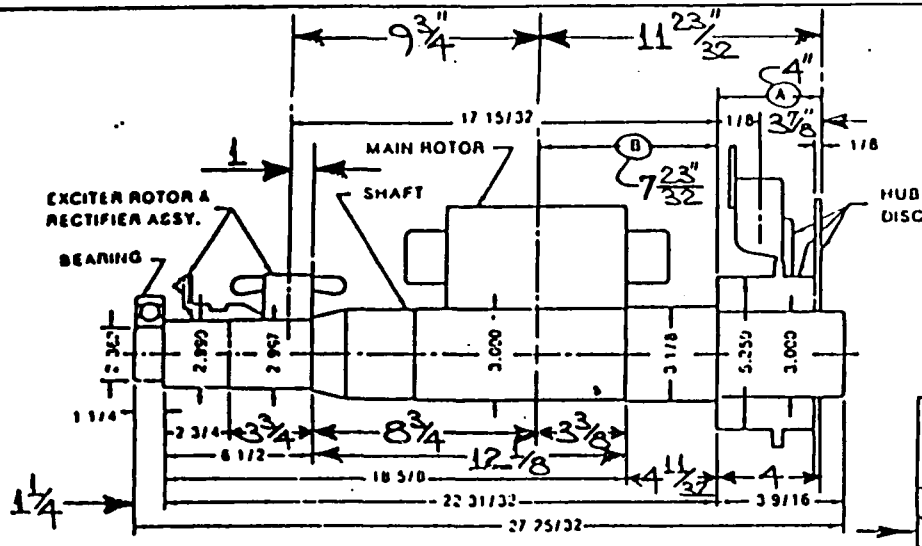
THE LIMA ELECTRIC CO., INC.

200 East Chapman Road Lima, Ohio 45802

Telephone 419/227-7327 TWX 610/447-2730

L-0103

CERTIFIED CORRECT FOR
CUSTOMER ORDER NO.
LIMA ORDER NO.
DATE BY



WT. IN LBS. WR^2 IN LBS. FT. SQ

WND NO	B.	EXC ROTOR & RECT.ASSY		SHAFT		MAIN ROTOR		HUB,FAN & DISC ASSY		TOTAL		RADIAL AIR GAP IN INCHES	UNBALA MAGN PULL IN
		WT	WR^2	WT	WR^2	WT	WR^2	WT	WR^2	WT	WR^2		
0009	7-3/32	18.8	.9	55	.44	127.1	13.8	27.1	2.6	228	17.7	.062	232
0010	7-23/32	18.8	.9	55	.44	153.5	16.6	27.1	2.6	254.4	20.5	.062	237
0037	6-15/32	18.8	.9	55	.44	100.7	10.9	27.1	2.6	201.6	14.8	.062	169
0038	7-3/32	18.8	.9	55	.44	127.1	13.8	27.1	2.6	228	17.7	.062	193
0039	7-23/32	18.8	.9	55	.44	153.9	16.6	27.1	2.6	254.4	20.5	.062	237
0057	6-3/32	18.8	.9	55	.44	84.9	9.2	27.1	2.6	185.8	13.1	.062	191
0058	6-15/32	18.8	.9	55	.44	100.7	10.9	27.1	2.6	201.6	14.8	.062	210
0059	6-27/32	18.8	.9	55	.44	116.6	12.6	27.1	2.6	217.5	16.5	.062	246
0060	7-7/32	18.8	.9	55	.44	132.4	14.3	27.1	2.6	233.3	18.2	.062	272
0082	6-3/32	18.8	.9	55	.44	84.9	9.2	27.1	2.6	185.8	13.1	.062	191
0083	6-15/32	18.8	.9	55	.44	100.7	10.9	27.1	2.6	201.6	14.8	.062	218
0084	6-27/32	18.8	.9	55	.44	116.6	12.6	27.1	2.6	217.5	16.5	.062	246
0085	7-7/32	18.8	.9	55	.44	132.4	14.3	27.1	2.6	233.3	18.2	.062	272
0967	6-15/32	18.8	.9	55	.44	100.7	10.9	27.1	2.6	201.6	14.8	.062	169
0976	7-3/32	18.8	.9	55	.44	127.1	13.8	27.1	2.6	228	17.7	.062	193
0977	7-23/32	18.8	.9	55	.44	153.5	16.6	27.1	2.6	254.4	20.5	.062	237
0994	6-15/32	18.8	.9	55	.44	100.7	10.9	27.1	2.6	201.6	14.8	.062	169
005	6-15/32	18.8	.9	55	.44	93.0	10.1	27.1	2.6	193.0	14.8	.062	214

* Calculated for 10% eccentricity of Radial Air Gap & At 480 Volts.

SAE ADAPTER	CLUTCH DESCRIPTION	A
No. 4	C-107	4 1/8
No. 4	C-108	5-3/8
No. 4	C-110	5
No. 4	SP-111	4-7/16
No. 3	C-108	4-5/16
No. 3	C-110	4
No. 3	SP-111	3-7/16
No. 3	SP-111 2-1/8G	4
No. 2	C-110	4-9/16
No. 2	C-110 1-7/8G	4-5/16
NO. 2	SP-111	4
No. 2	Det.Dsl. 15.500	3-7/16
No. 2	Det.Dsl.1-9/16G	4-5/16
No. 1	SP-111	4
No. 1	SP-114	3-7/16
No. 1	Det.Dsl. 17.750	3-7/16

SECTION NO. SWG SP

D3400X290

FEATURES AND TECHNICAL DESCRIPTION OF THE 3.7 SERIES II ENGINE

- 4 cylinder in-line diesel engine of 3.7 liter (226 in^3) displacement employing direct fuel injection with a re-entrant bowl open chamber combustion system at 16.0:1 compression ratio.
- FUEL INJECTION SYSTEM
  * Robert Bosch Model VE fuel injection pump w/boost compressor
  * 17mm nozzle with 4 - .295mm orifices in a 155° spray cone .062" I.D. high pressure fuel pipes
- POWER CYLINDER
  * New short skirt aluminum alloy piston (non-strut) with top ring groove iron insert
  * Larger 1.5" O.D. tubular type wrist pin
  * New alloy steel connecting rod with extended center distance and sleeve dowel type bolts
  * New 3 ring combination with excellent oil control
  * Piston cooling jets in each cylinder
- MAIN AND ROD BEARINGS
  * F112 Clevite copper-lead tri-metal rod and main bearings
  * Increased tensile strength nodular iron main bearing cap material (80,000 psi tensile)
  * Solid hex-head capscrew w/harden washers for main bearing caps (SAE grade 8 material)
- EXHAUST SYSTEM AND TURBOCHARGERS
  * New divided exhaust manifold for pulse energy utilization of compacted graphite iron material
  * AiResearch T31 divided turbine-type matched for high efficiency

Attachment 5

Cont'd

- CYLINDER HEAD
  - Higher strength alloy iron (35,000 psi tensile strength)
  - New silichrome XB intake valve seat insert
  - New cobalt base material exhaust valve seat insert
  - New valves with improved flow shape of 21-2n austenitic stainless steel material and flash chrome stems
  - Increased stem/guide clearance
  - Revised coolant flow via brass water directors (2/cyl)
  - Recontoured top deck with increased section thickness
  - Added dowels for consistent positioning to crankcase
- CRANKCASE AND GEAR TRAIN
  - 35,000 psi tensile strength gray iron material
  - Redesigned idler gear mounting arrangement into front face of crankcase
  - Added midship mounting bosses for improved balance in chassis
  - Re-evaluated coolant flow through crankcase
  - Added full time piston cooling jet oil feed channels
  - Revised luboil filter mounting arrangement
  - Added all rubber saddle seals to replace cork -- also machined saddles
  - New forged steel fuel injection pump drive gear
  - Camshaft bushings at all journal positions
- CRANKSHAFT
  - Forged steel case hardened crankshaft
- CAMSHAFT/TAPPETS/ROCKERS
  - Steel tappets
  - Alloy cast iron camshaft
  - Ductile cast iron rocker arms

Cont'd

- LUBRICATION SYSTEM
  - Gear-type oil pump
  - Full flow oil cooler added (tube and shell-type using jacket coolant or radiator fin-type options)
- INTERCOOLER
  - An air to air charge air cooler mounted forward of the radiator will be standard for California in 1987 and 50 states in 1988. In 1987 it will be available for 49 State as a fuel economy option. All 126 BHP/ 2800 RPM version will use the intercooler.

II. 3.7 LITER SERIES II MODEL VARIANTS/RATINGS/CERTIFICATION STATUS

ALL MODEL VARIANTS CONTAIN IDENTICAL BASIC ENGINE COMPONENTS EXCEPT FOR FUEL INJECTION SYSTEM COMPONENTS AND TIMING. THE INTERCOOLED MODELS USE AN AIR TO AIR INTERCOOLER TO BE LOCATED IN FRONT OF THE ENGINE COOLANT RADIATOR.

THE CHART ON THE FOLLOWING PAGE TABULATES THE MODEL VARIANT, ITS HORSEPOWER AND TORQUE PEAK, THE APPLICABLE POWER CURVE, CERTIFICATION STATUS AND CALENDAR YEAR. THE CHOICE OF MODEL VARIANT TO BE USED WITH A PARTICULAR APPLICATION IS MADE AFTER STUDY OF CUSTOMER OBJECTIVES, VEHICLE PERFORMANCE PREDICTIONS AS COMPUTED PER SAE J688, AND OTHER APPLICATION RELATED FACTORS.

HERCULES
ENGINES, INC.

3.7L SERIES II MODEL VARIANTS

MODEL	MAX. RATING BHP/RPM	TORQUE PEAK LB-FT/RPM	POWER CURVE	CERTIFICATION STATUS (HEAVY DUTY)
DT3.7	108/2800	267/1800	DX1821	49 STATE 1987
DTI3.7	107/2800	275/1600	DX1822	CALIFORNIA 1987, 1988, 1989, 1990 49 STATE 1988, 1989, 1990
DTI3.7 FUEL ECONOMY VERSION	112/2800	290/1800	DX1823	49 STATE 1987
DTI3.7	125/2800	285/1800	DX1824P	50 STATE VERIFIED ON 13 MODE BASIS. TRANSIENT CERTIFICATION TEST PENDING

NOTE: VEHICULAR EMISSION TESTING LEADING TO LIGHT DUTY EMISSION "CERTIFICATION" HAS NOT BEEN UNDERTAKEN AT THIS TIME.

DT3.7 SERIES II

EXHAUST EMISSIONS TEST SUMMARY

COLD START TRANSIENT TEST RESULTS

Configuration*	Exhaust Emissions (GMS/BHP-HR)				Smoke Emissions (Percent)		
	HC	CO	NOx**	Part.	Accel.	Lug	Peak
1) Turbo	0.67	1.84	10.22	0.486	8.6	7.5	16.7
2) Turbo/Aftercooled	0.81	2.34	5.40	0.484	7.2	3.4	15.1
3) Turbo/Aftercooled	0.64	1.78	9.00	0.481	7.1	3.9	15.4
Standards 1987 USEPA	1.3	15.5	10.7	N/A	20	15	50
Standards 1988-1990 USEPA (1987 Calif. Option)	1.3	15.5	6.0	0.6	20	15	50

*1) Configuration for 1986/1987 Federal

2) Configuration for 1987 California and 50 states 1988 thru 1990

3) Configuration for 1987 Federal improved fuel economy

** NOx based on continuous sample

Testing conducted by Southwest Research Institute in 1986.

1986 U. S. EPA certification document shown on following page will be carried over to 1987 upon reapplication.

1987 CARB certification submittal in preparation.

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

ANN ARBOR, MICHIGAN 48105

August 27, 1986

OFFICE OF
AIR, NOISE AND RADIATION

Mr. Robert J. Holtgreive
Executive Vice President-Engineering
and Marketing
White Engines, Inc.
P.O. Box 6904
Canton, OH 44707

1986 MODEL YEAR
CERTIFICATE OF CONFORMITY
WITH THE CLEAN AIR ACT OF 1970 ISSUED TO:

White Engine, Inc.	White-HDD-3	August 27, 1986
MANUFACTURER	CERTIFICATE NUMBER	DATE

Pursuant to Section 206 of the Clean Air Act (42 U.S.C. 7525) and 40 CFR Part 86, and subject to the terms and conditions prescribed in those provisions, this certificate of conformity is hereby issued with respect to the test vehicles or engines which have been found to conform to applicable requirements and which represent the following motor vehicles or motor vehicle engines, by engine and/or evaporative family, more fully described in the documentation required by 40 CFR Part 86 and produced in the stated model year:

GWE03.7EAB3.

This certificate of conformity covers only those new motor vehicles or new motor vehicle engines which conform, in all material respects, to the design specifications that applied to those vehicles or engines described in the documentation required by 40 CFR Part 86 and which are produced during the model year production period stated on this certificate of the said manufacturer, as defined in 40 CFR Part 86.

It is a term of this certificate that the manufacturer shall consent to all inspections described in 40 CFR 86.078-7(c), 86.441, 86.606, and 86.1006 and authorized in a warrant or court order. Failure to comply with the requirements of such a warrant or court order may lead to revocation or suspension of this certificate as specified in 40 CFR 86.085-30(c), (d), or (e) or 86.442. It is also a term of this certificate that this certificate may be revoked or suspended for the other reasons stated in 40 CFR 86.085-30 (c), (d), or (e) or 86.442.

Robert E. Maxwell
OFFICE OF MOBILE SOURCES

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

ANN ARBOR, MICHIGAN 48105
November 4, 1986

OFFICE OF
AIR AND RADIATION

Mr. Robert J. Holtgreive
Executive Vice President-Engineering
and Marketing
White Engines, Inc.
P.O. Box 6904
Canton, OH 44707

1987 MODEL YEAR
CERTIFICATE OF CONFORMITY
WITH THE CLEAN AIR ACT OF 1970 ISSUED TO:

White Engines, Inc.	White-HDD-2	November 4, 1986
MANUFACTURER	CERTIFICATE NUMBER	DATE

Pursuant to Section 206 of the Clean Air Act (42 U.S.C. 7525) and 40 CFR Part 86, and subject to the terms and conditions prescribed in those provisions, this certificate of conformity is hereby issued with respect to the test vehicles or engines which have been found to conform to applicable requirements and which represent the following motor vehicles or motor vehicle engines, by engine and/or evaporative family, more fully described in the documentation required by 40 CFR Part 86 and produced in the stated model year:

DT 3.7 - 49 state
non-intercooled

HEAVY-DUTY DIESEL ENGINE FAMILY: HWE03.7EAB2.

This certificate of conformity covers only those new motor vehicles or new motor vehicle engines which conform, in all material respects, to the design specifications that applied to those vehicles or engines described in the documentation required by 40 CFR Part 86 and which are produced during the model year production period stated on this certificate of the said manufacturer, as defined in 40 CFR Part 86.

It is a term of this certificate that the manufacturer shall consent to all inspections described in 40 CFR 86.078-7(c), 86.441, 86.606, and 86.1006 and authorized in a warrant or court order. Failure to comply with the requirements of such a warrant or court order may lead to revocation or suspension of this certificate as specified in 40 CFR 86.087-30(c), (d), or (e) or 86.442. It is also a term of this certificate that this certificate may be revoked or suspended for the other reasons stated in 40 CFR 86.087-30 (c), (d), or (e) or 86.442.

Robert E. Maxwell
OFFICE OF MOBILE SOURCES

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

ANN ARBOR, MICHIGAN 48105

January 22, 1987

OFFICE OF
AIR AND RADIATION

Mr. Robert J. Holtgreive
Executive Vice President
White Engines, Inc.
101 Eleventh Street, S.E.
Canton, OH 44707

1987 MODEL YEAR
CERTIFICATE OF CONFORMITY
WITH THE CLEAN AIR ACT OF 1970 ISSUED TO:

White Engines, Inc.	White-HDD-3	January 22, 1987
MANUFACTURER	CERTIFICATE NUMBER	DATE

Pursuant to Section 206 of the Clean Air Act (42 U.S.C. 7525) and 40 CFR Part 86, and subject to the terms and conditions prescribed in those provisions, this certificate of conformity is hereby issued with respect to the test vehicles or engines which have been found to conform to applicable requirements and which represent the following motor vehicles or motor vehicle engines, by engine and/or evaporative family, more fully described in the documentation required by 40 CFR Part 86 and produced in the stated model year:

HEAVY-DUTY DIESEL ENGINE FAMILY: HWE03.7FAA4.
Charge air cooled for California. Must still obtain Calif. Exec. Order.

This certificate of conformity covers only those new motor vehicles or new motor vehicle engines which conform, in all material respects, to the design specifications that applied to those vehicles or engines described in the documentation required by 40 CFR Part 86 and which are produced during the model year production period stated on this certificate of the said manufacturer, as defined in 40 CFR Part 86.

It is a term of this certificate that the manufacturer shall consent to all inspections described in 40 CFR 86.078-7(c), 86.441, 86.606, and 86.1006 and authorized in a warrant or court order. Failure to comply with the requirements of such a warrant or court order may lead to revocation or suspension of this certificate as specified in 40 CFR 86.087-30(c), (d), or (e) or 86.442. It is also a term of this certificate that this certificate may be revoked or suspended for the other reasons stated in 40 CFR 86.087-30 (c), (d), or (e) or 86.442.

Robert E. Maxwell
OFFICE OF MOBILE SOURCES

6452b

cc: J. Scheetz
J. Lennon
E. Zembrzuski
T. Bednar
T. Waterfall
E. Kienzle
E. Caruso

State of California
AIR RESOURCES BOARD

EXECUTIVE ORDER A-42-19
Relating to Certification of New Heavy-Duty Motor Vehicle Engines

WHITE ENGINES, INC.

Pursuant to the authority vested in the Air Resources Board by Sections 43100, 43102, and 43103 of the Health and Safety Code; and

Pursuant to the authority vested in the undersigned by Sections 39515 and 39516 of the Health and Safety Code and Executive Order G-45-3;

IT IS ORDERED AND RESOLVED: That the following White Engines, Inc. 1987 model-year diesel engines have shown compliance with the transient test procedures and standards and are certified for use in motor vehicles with a manufacturer's gross vehicle weight rating (GVWR) over 8,500 pounds:

Engine Family	Displacement Cubic Inches (Liters)		Exhaust Emission Control Systems (Special Features)
HWE03.7FAA4	226	(3.7)	(Diesel Injection-Direct) (Turbocharger) (Intercooler)

Engine models and codes are listed on attachments.

The following are the certification emission values for these engine families:

Engine Family	Hydrocarbons gm/bhp-hr	Carbon Monoxide gm/bhp-hr	Nitrogen Oxides gm/bhp-hr	Particulates gm/bhp-hr
HWE03.7FAA4	0.91	2.7	5.8	0.5

BE IT FURTHER RESOLVED: That the Executive Officer has been provided all material required to demonstrate certification compliance with the Board's emission control system warranty regulations (Title 13, California Administrative Code, Section 2036).

Engines certified under this Executive Order must conform to all applicable California emission regulations.

The Bureau of Automotive Repair will be notified by copy of this order.

Executed at El Monte, California this 17th day of February, 1987.

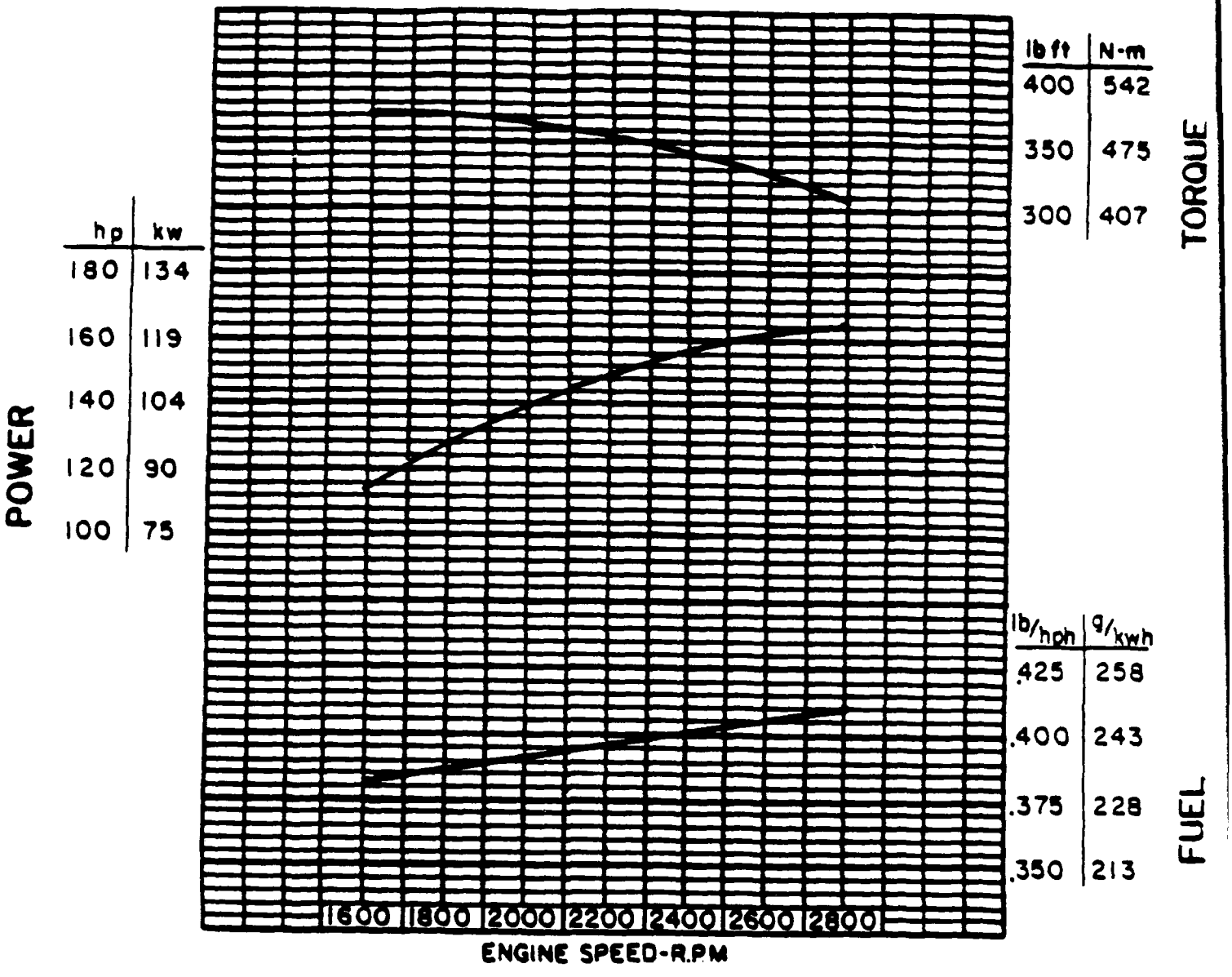
K. D. Drachand, Chief
Mobile Source Division

ENGINES INC
CANTON OHIO 44707

POWER CHART Nº. DX-189

PRELIMINARY

MODEL	NO. OF CYL.	BORE	STROKE	DISPLACEMENT
DT-5.6	6	4.00IN. (101.6MM)	4.50IN. (114.3MM)	339 CU.IN. (5.56L)



Engine performance per SAE standard J1349 conditions (29.31 in. Hg. barometer, 77°F. air intake temperature, 0.30 in. Hg. water vapor pressure) using No. 2 diesel fuel. Actual performance may vary with different ambient conditions. New engine power will be within - 3% of curve shown.

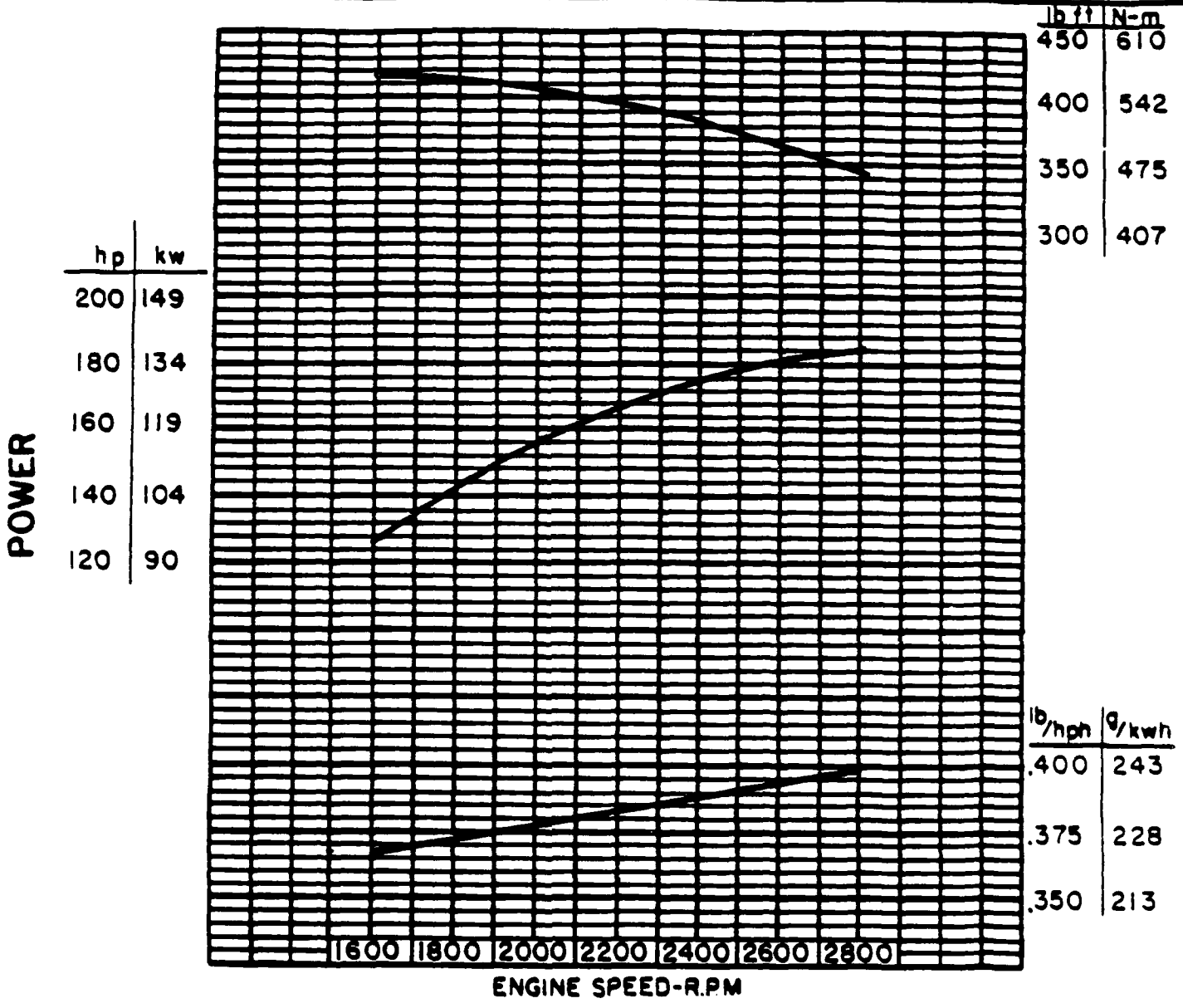
Curves shown represent performance of engine without alternator, power steering pump, vacuum pump, air compressor, and fan.

WHITE ENGINES INC
CANTON OHIO 44707

POWER CHART Nº. DX-1820

PRELIMINARY

MODEL	NO. OF CYL.	BORE	STROKE	DISPLACEMENT
DTI-5.6	6	4.00IN. (101.6MM)	4.50IN. (114.3MM)	339 CU.IN. (5.56L)



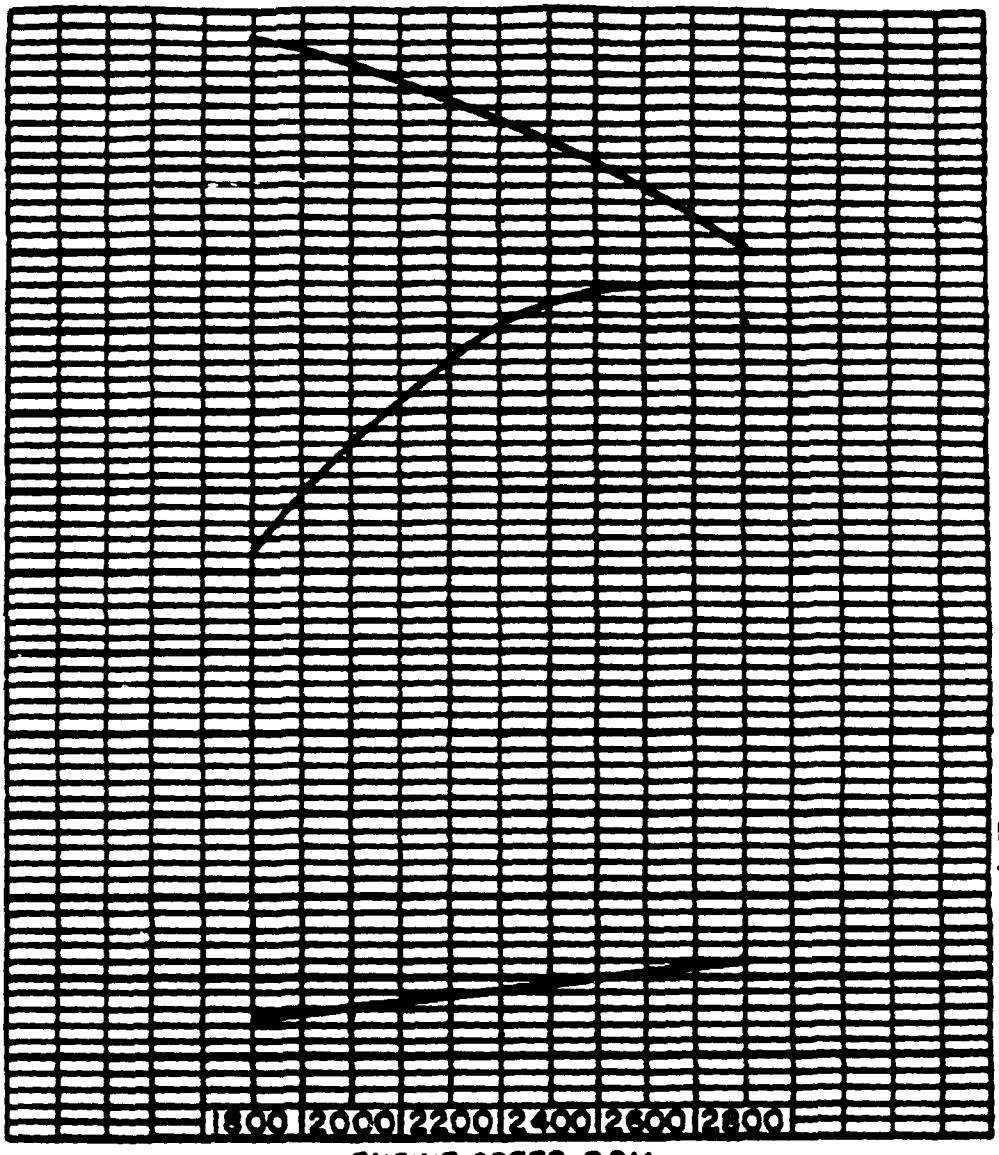
Engine performance per SAE standard J1349 conditions (29.31 in. Hg barometer, 77°F. air intake temperacure, 0.30 in. Hg. water vapor pressure) using No. 2 diesel fuel. Actual performance may vary with different ambient conditions. New engine power will be within - 5% of curve shown.

Curves shown represent performance of engine without alternator, power steering pump, vacuum pump, and air compressor.

ENGINES INC
CANTON OHIO 44707

POWER CHART Nº. DX-1821

MODEL	NO. OF CYL.	BORE	STROKE	DISPLACEMENT
JT-3.7 49 STATE	4	4.00 IN. (101.6 MM)	4.50 IN. (114.3 MM)	226 CU.IN. (3.7L)



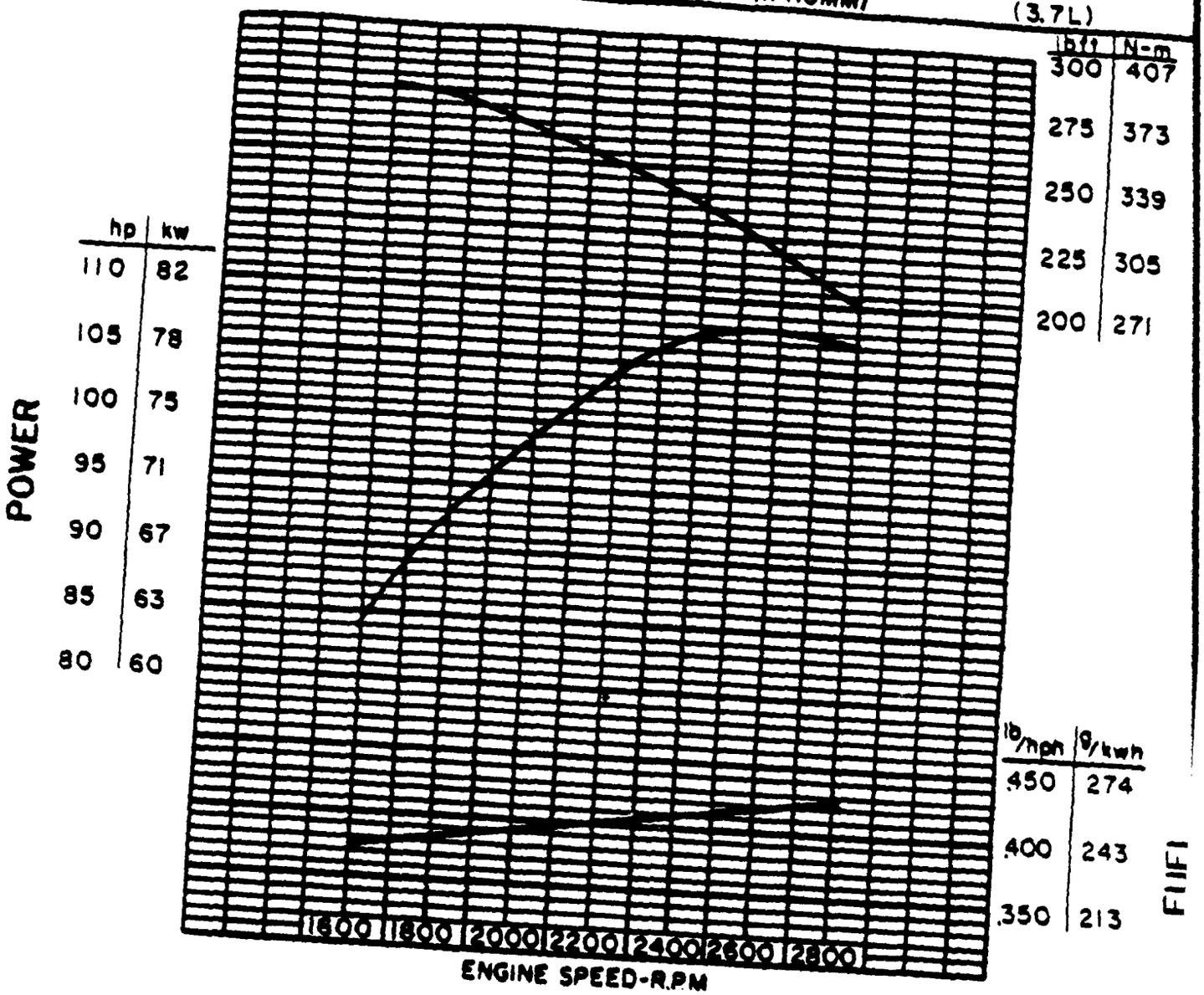
Engine performance per SAE standard J1349 conditions (29.31 in. Hg barometer, 77°F. air intake temperature, 0.30 in. Hg water vapor pressure) using No. 2 diesel fuel. Actual performance may vary with different ambient conditions. New engine power will be within - 5% of curve shown.

Curves shown represent performance of engine without alternator, power steering pump, vacuum pump, air compressor, and fan.

ENGINES INC
CANTON OHIO 44707

POWER CHART Nº DX-822

MODEL	NO. OF CYL.	BORE	STROKE	DISPLACEMEN
TI-3.7 50 STATE	4	4.00 IN. (101.6MM)	4.50 IN. (114.3MM)	226 CU. IN. (3.7L)



Engine performance per SAE standard J1349 conditions (29.31 in. Hg barometer, 77°F. air intake temperature, 0.30 in. Hg water vapor pressure) using No. 2 diesel fuel. Actual performance may vary with different ambient conditions. New engine power will be within - 5% of curve shown.

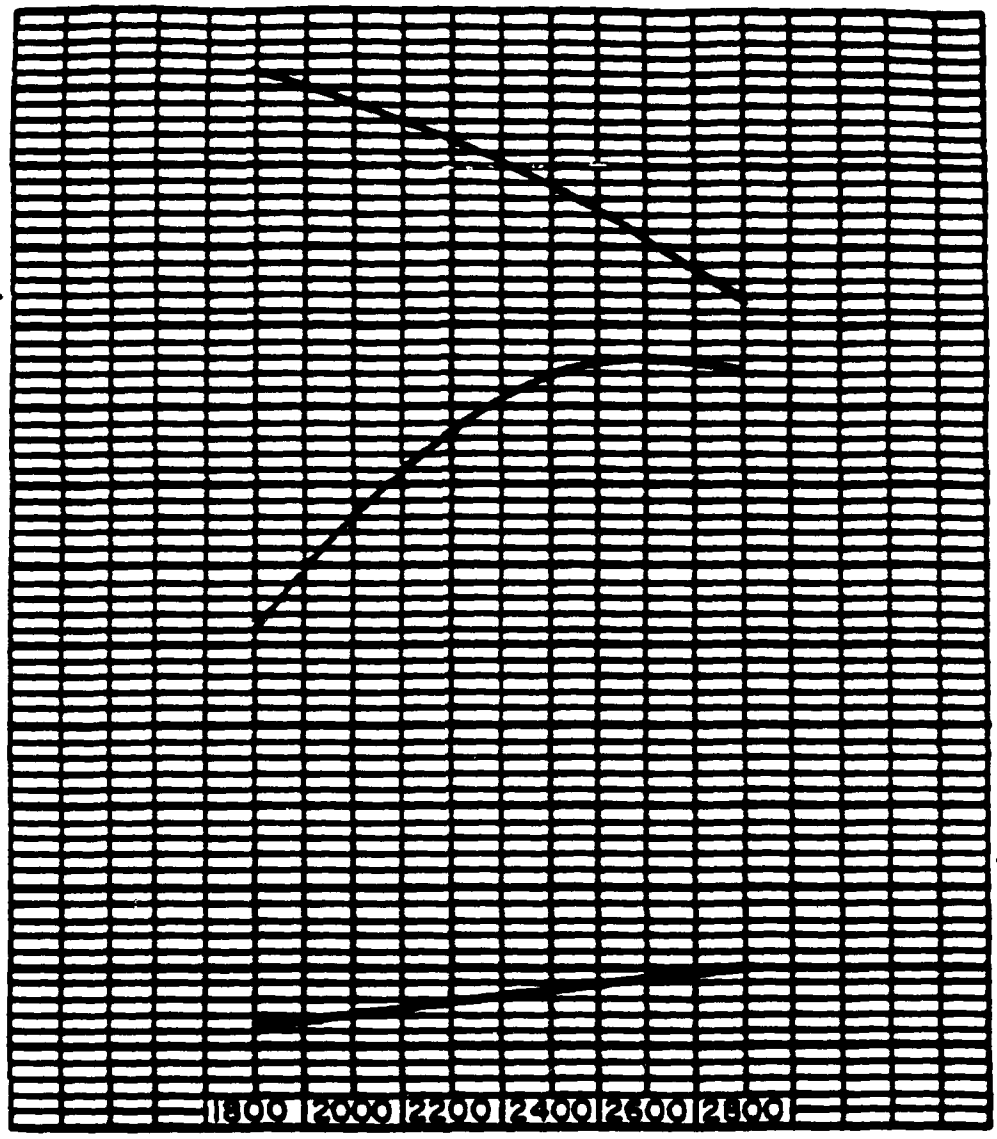
Curves shown represent performance of engine without alternator, power steering pump, vacuum pump, and air compressor.

FIFI

ENGINES, INC.
CANTON, OHIO 44707

POWER CHART No. DX-1823

MODEL	NO. OF CYL.	BORE	STROKE	DISPLACEMENT
DTI-3.7 .9 STATE	4	4.00 IN. (101.6 MM)	4.50 IN. (114.3 MM)	226 CU. IN. (3.7 L)



Engine performance per SAE standard J1349 conditions (29.31 in. Hg barometer, 77°F. air intake temperature, 0.30 in. Hg water vapor pressure) using No. 2 diesel fuel. Actual performance may vary with different ambient conditions. New engine power will be within - 3% of curve shown.

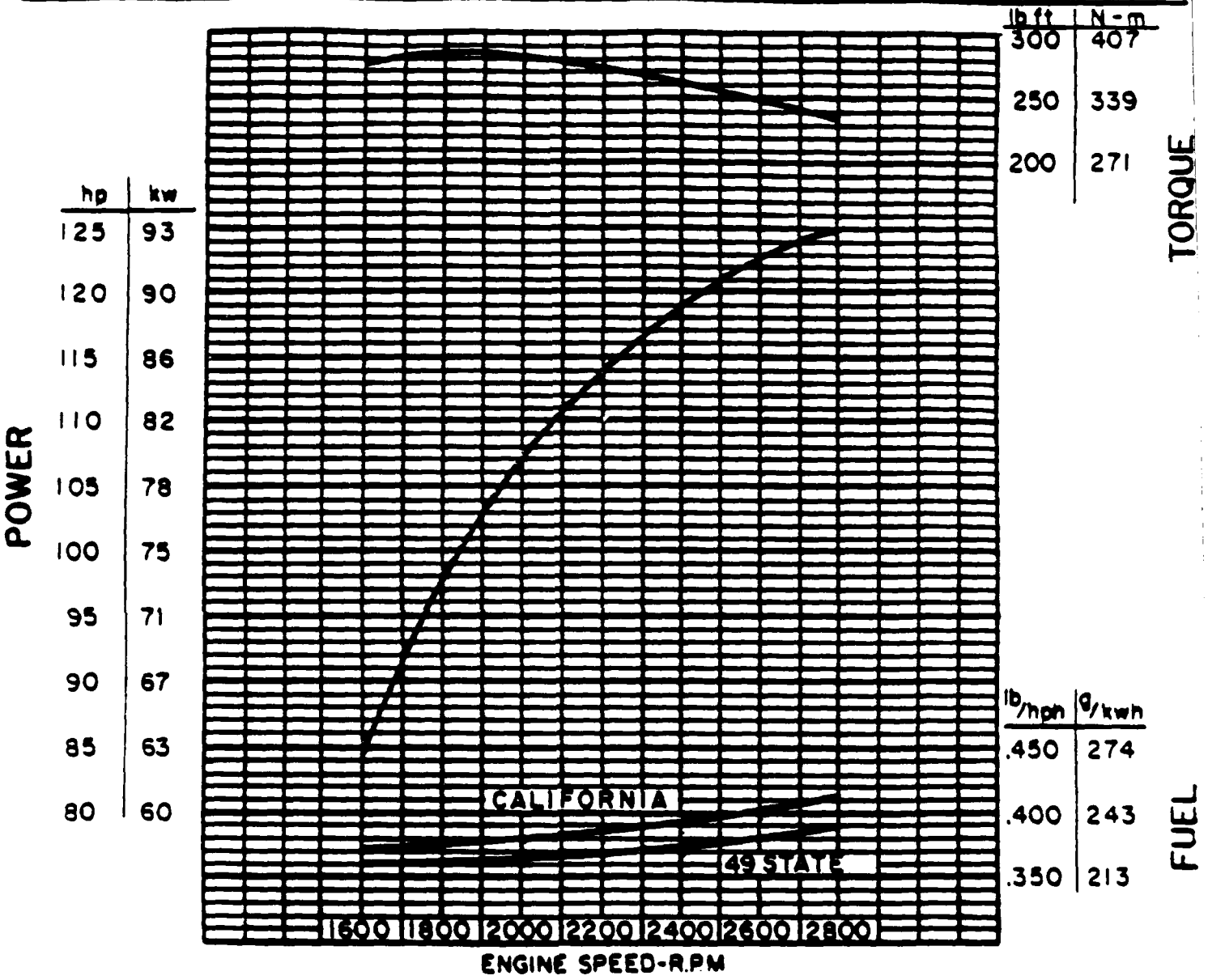
Curves shown represent performance of engine without alternator, power steering pump, vacuum pump, and air compressor.

HERCULES
ENGINES INC
CANTON OHIO 44707

POWER CHART Nº. DX-1824 =

PRELIMINARY

MODEL	NO. OF CYL.	BORE	STROKE	DISPLACEMENT
TI-3.7 50 STATE	4	4.00 IN. (101.6MM)	4.50 IN. (114.3 MM)	226 CU.IN. (3.7 L)



Engine performance per SAE standard J1349 conditions (29.31 in. Hg barometer, 77°F. air intake temperature, 0.30 in. Hg water vapor pressure) using No. 2 diesel fuel. Actual performance may vary with different ambient conditions. New engine power will be within - 5% of curve shown.

Curves shown represent performance of engine without alternator, power steering pump, vacuum pump, and air compressor.

WHITE
ENGINES, INC.

P O BOX 6904
CANTON OHIO 44706
PHONE (216) 454-5631
TELEX 98-3439 WHTENGS CTN

May 9, 1985

Col. Charles S. Green, Jr.
Project Manager
Mobile Electric Power
7500 Backlick Road
Springfield, Virginia 22150

Dear Col. Green:

White Engines, Inc. is pleased to submit this Unsolicited Proposal to the Project Manager's Office for consideration to re-engine the 60 kW DoD military standard generator set.

White Engines, Inc. has been a long time supplier of engines to the military and has the technical capability and product to meet the stringent military specification requirements.

This program will receive top priority to meet the goals and objectives as presented by White Engines, Inc.

We would be pleased to provide any additional information required to clarify this Proposal.

Yours truly,

WHITE ENGINES, INC.

Robert J. Holtgreive
Executive Vice President

/jb

ATTACHMENT 1

WHITE
ENGINES, INC.

P O BOX 6904
CANTON OHIO 44706
PHONE (216) 454-5631
TELEX-98-3439 WHTENGS CTN

May 9, 1985

UNSOLICITED PROPOSAL TO PROJECT MANAGER'S OFFICE

White Engines, Inc. is making this Unsolicited Proposal to the Project Manager's Office for the purpose of offering an optional engine source for current and new production 60 kW DoD generator sets. Based on recent editorial releases, we are of the understanding that the Allis-Chalmers manufacturing facility will be closed in the near future and we anticipate a military need to obtain a replacement engine for future production and service.

PROPOSAL

White Engines, Inc. has completed sufficient design and prototype testing to assure that we can provide the military with a totally interchangeable (100% drop-in) engine for the 60 kW DoD generator set that will meet all specification requirements. White Engines is proposing the D-3400T engine which is of the same family as the 4 and 6-cylinder engines which are standard in the 15 and 30 kW DoD generator sets. The D-3400T engine incorporates all design features to meet military requirements, and is a proven product having been sold commercially at 75 kW rating over the past seven (7) years.

White Engines is very familiar with the DoD specification requirements and is confident that the package, as proposed, will retain current military designed generator set components, will permit the Government to continue to solicit on a competitive bid basis, and will successfully meet all operational and functional specification requirements.

DESIGN STUDY

A recent design study (see enclosed layout) confirms that the military designed 60 kW DoD generator set can be re-engined with White Engines' D-3400T without anyother changes to the basic generator set. The following systems will remain unchanged: Cooling system, air cleaner system, exhaust system, fuel system, electrical system including generator, engine alternator, skid base, housing and controls.

The D-3400T engine design has the following accessories or components in the same location as the Allis-Chalmers engine which avoids any change in the above systems: Fuel injection pump assembly, tach drive and overspeed switch assembly, turbocharger assembly, oil filler and dip stick, starter, fan, water and oil sending units, trunnion mount (will bolt directly to current cross frame), and engine alternator. White Engines can locate the oil and fuel filter assembly in the same location as on the current 60 kW set, but propose per attached layout, to locate all filters for one side service.

The following components will be supplied by White Engines to accomplish the 100% interchangeability; Water inlet and outlet hoses, exhaust adapter and air inlet adapter.

PROTOTYPE TESTING

White Engines, Inc. recognizes that the motor starting test is the most difficult load requirement in the 60 kW DoD specification. A production D-3400T successfully passed the motor starting test when installed in a military 60 kW DoD generator set. The test results are available at White Engines for your review.

SOFTWARE

The D-3400T engine has a high degree of commonality with production engines used in the 15 and 30 kW DoD generator sets. In addition, the D-3400T is totally provisioned in the military supply system in that it is successfully being used in the U. S. Army Rapid Deployment Program, as well as other military applications. No additional components would be added to the military supply system by incorporating the proposed engine replacement in to the 60 kW DoD program.

TRAINING

In that the basic engine is essentially the same as used in the 30 kW DoD generator set, the addition of the turbo-charger minimizes field training requirements when introducing the White Engines' D-3400T engine.

PRODUCTION AND SERVICE

In that the D-3400T engine and associated parts have 100% drop-in replacement for the current Allis-Chalmers engine, the D-3400T can be incorporated into current production contracts without redesign or tooling of the military designed generator set components. The engine also can be used for drop-in replacement for field service requirements on current generator sets.

SCOPE OF WORK

In order to demonstrate the interchangeability and advantages in using the White Engines' proposed D-3400T engine, White Engines is offering to convert a current production 60 kW generator set with the understanding that the military will conduct performance and endurance tests. White Engines, Inc. will complete in-house performance tests prior to shipping units to Fort Belvoir. The re-engined generator set, all technical data and required test support will be supplied by White Engines, Inc. at no cost to the Government.

SUMMARY

White Engines, Inc. recommends that the military accept this proposal and proceed with hardware demonstrations, based on the many advantages to include:

- No changes to military designed generator set
- Proven engine available for production and service
- No new parts introduced into the military supply system
- Minimal supplement to current manual
- Minimal training required
- Slight reduction in total generator set weight

The D-198ER, D-2000, D-2300, D-2300T, D-298ER, D-3400 and D-3400T engines are designed under a Family Concept with interchangeable:

Pistons
Piston Rings
Piston Pins
* Connecting Rod
* Crank Gear
* Cam Gear
* Idler Gear
* Seals
* Oil Pumps
* Bearings - Rod and Main
* Valves
* Valve Guides
* Valve Springs
* Fuel Filters
* Oil Filters
* Alternator
* Front Housing
* Front Cover
* Tappets
* Push Rods
* Rocker Arms
* Water Pump Assembly

(*) Common with engines in current DoD 15 kW and 30 kW gen. sets

MILITARY APPLICATION USING PROPOSED 4 INCH BORE ENGINES

* Roland Missile
* Military Air Compressors
* Rapid Deployment Pumps
* The D-2300 and D-3400 engines completed 20,000 hrs. on DoD durability test schedule (4 engines - 5,000 hrs. each)

MILITARY APPLICATIONS USING 3-3/4 INCH BORE ENGINES

* DoD 15 kW and 30 kW gen. sets
* Mobile Shop Vans
* Rough - Terrain Vehicles
* Lift Trucks
* Mine Dispensers
* Air Compressors
* Pumps
* Air Conditioners

SPECIFICATION ITEMS

D-340OT ENGINE

Bore and Stroke	4-4½
Displacement	5.6 litre (339 CID)
No. of Cylinders	6
Combustion System	DI-Turbo
Fuel System	Stanadyne DB-2
Horsepower	132 at 1800; 145 at 2000 RPM
Compression Ratio	16:1
Luboil Capacity - Qts. (w/filter)	8
Cooling System Capacity - Gal. (including radiator)	7

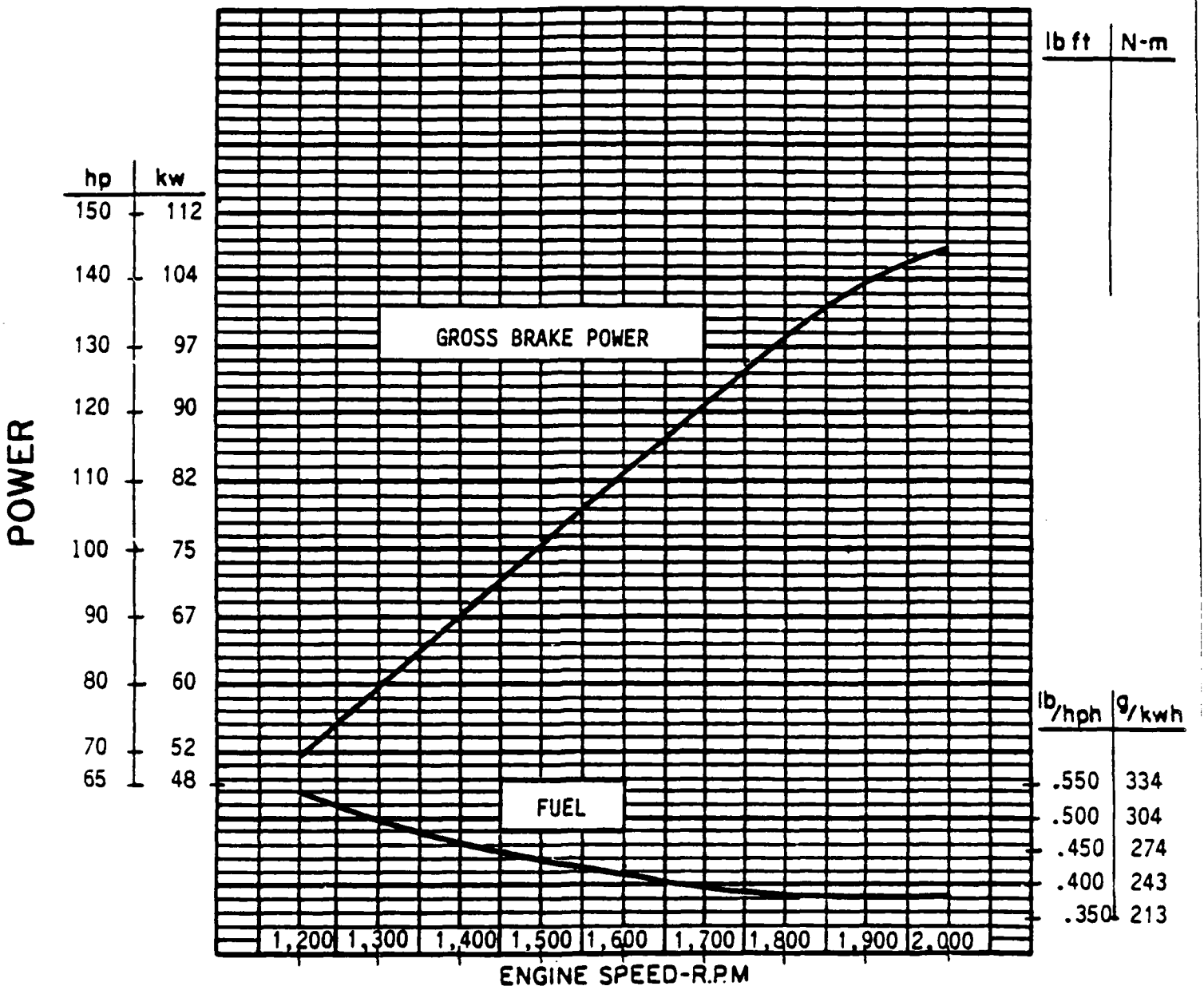
ENGINE SPEED

	1800 RPM
Coolant flow in GPM	31
Heat rejection to coolant Btu/BHP/Min.	30
CFM air for cooling	7200
CFM air for combustion	245
° F. exhaust temp. at full load	975
CFM exhaust gas flow a full load	630
Max. allowable total exhaust back pressure	2.5" HG or 35" H_2O
Exhaust outlet - pipe thread	3"
Approx. lbs. wt. gen. set open power unit	1075

ENGINES, INC
CANTON, OHIO 44707

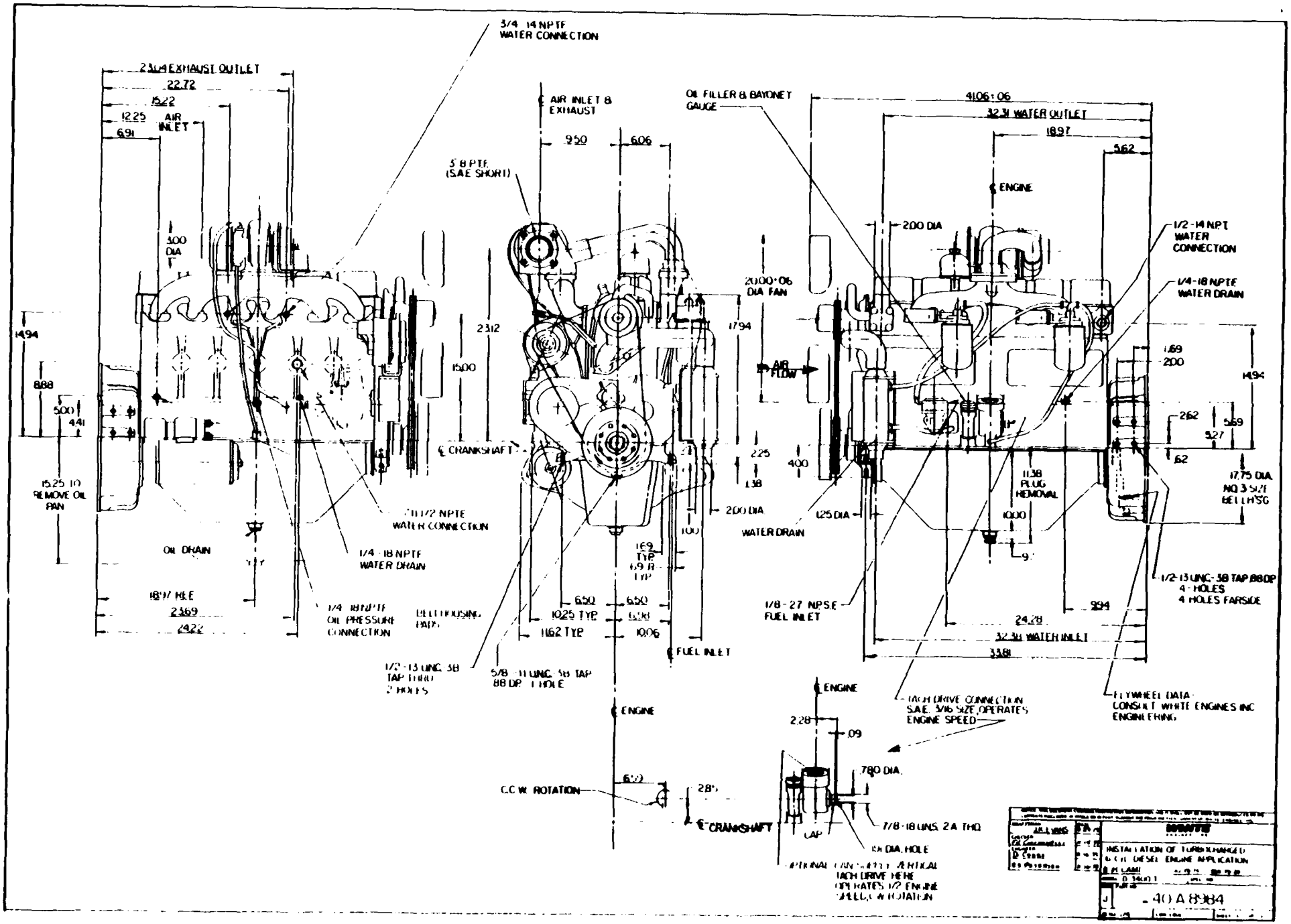
POWER CHART Nº. DX-1778

MODEL	NO. OF CYL.	BORE	STROKE	DISPLACEMENT
D3400T	6	4.00 IN.	4.50 IN.	339 CU. IN.
ERATOR SET APPLICATION		(101.6 MM)	(114.3 MM)	(5.56 L)



NOTE:

1. DATA BASED ON SAE J1349. DOES NOT INCLUDE FAN OR ANY POWER ABSORBING ACCESSORIES.
2. ALTITUDE CORRECTION:
   DEDUCT 2% PER 1000 FT. (304.8M) ABOVE 500 FT. (152.4M).
3. TEMPERATURE CORRECTION:
   DEDUCT 1% PER 10° (5.6°C) ABOVE 77° (25.0°C)

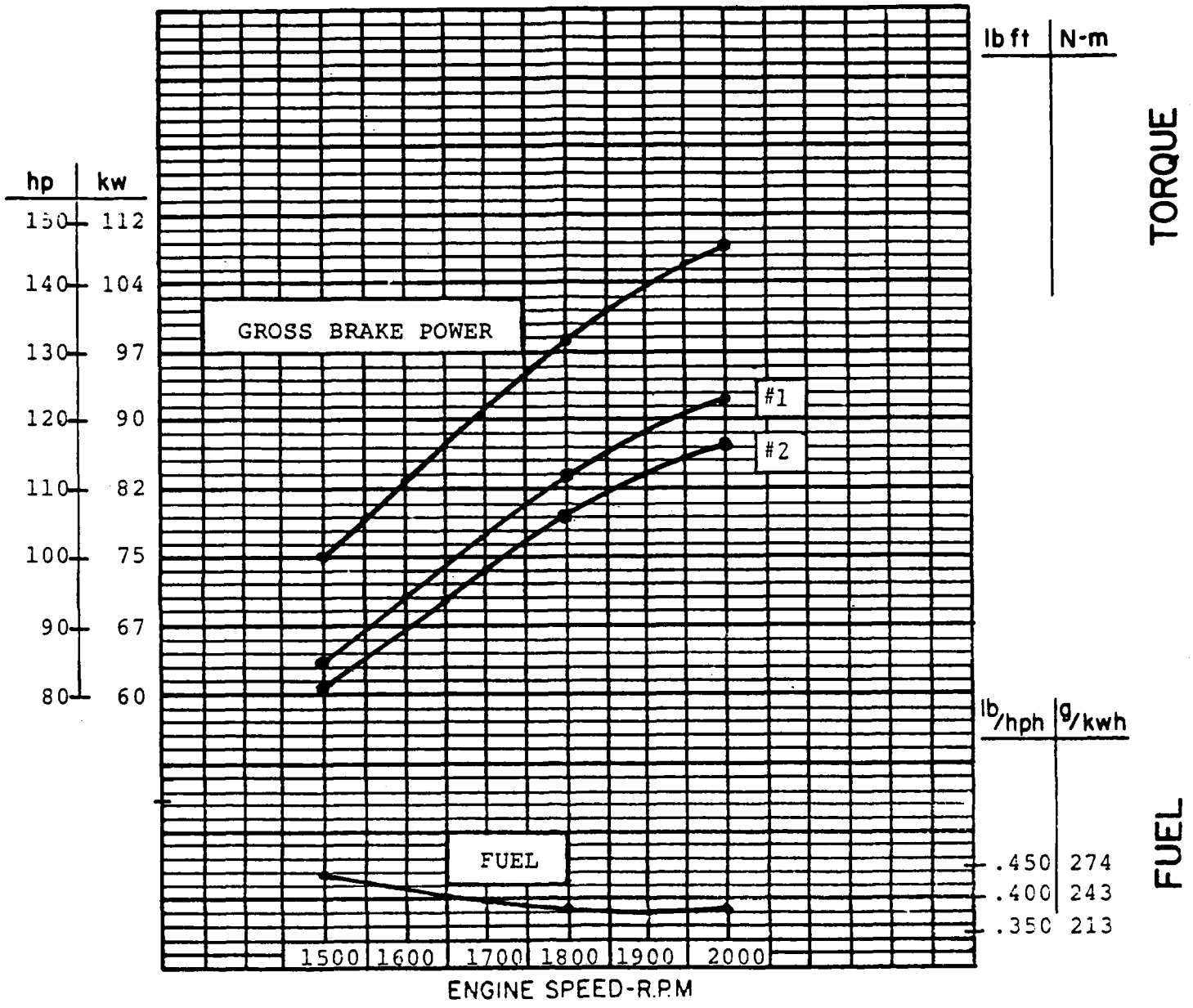

3/4-14 NPTF WATER CONNECTION
23.49 EXHAUST OUTLET
22.72
15.22
12.25 AIR INLET
6.91
5.00 DIA
14.94
8.88
5.00
4.41
15.25 TO REMOVE OIL PAN
OIL DRAIN
18.97 MLE
23.69
24.22
1/4-18 NPTF OIL PRESSURE CONNECTION
BELL HOUSING BOLTS
1/2-13 UNC. 3B TAP THRU 2 HOLES
5/8-11 UNC. 3B TAP 88 DP. 1 HOLE
1/4-18 NPTF WATER DRAIN
1/2-14 NPTF WATER CONNECTION
5/8 PTF (SAE SHORT)
AIR INLET & EXHAUST
9.50
6.06
23.12
15.00
CRANKSHAFT
1.69 TYP
6.98 TYP
6.50
10.25 TYP
11.62 TYP
6.50
6.98
10.06
FUEL INLET
ENGINE
CRANKSHAFT
OIL FILLER & BAYONET GAUGE
41.06:06
32.31 WATER OUTLET
18.97
5.62
ENGINE
20.0 DIA
2000:06 DIA FAN
17.94
AIR FLOW
2.25
1.38
4.00
20.0 DIA
WATER DRAIN
12.5 DIA
1/2-14 NPT WATER CONNECTION
1/4-18 NPTF WATER DRAIN
1.69
2.00
14.94
2.62
5.69
5.27
.62
11.38 PLUG REMOVAL
10.00
.9
17.75 DIA NO 3 SAE BELLHSG
1/2-13 UNC-3B TAP 88DP 4-HOLES 4 HOLES FARSIDE
1/8-27 NPSF FUEL INLET
9.94
24.28
32.31 WATER INLET
33.81
TACH DRIVE CONNECTION S.A.E. 5/16 SIZE, OPERATES ENGINE SPEED
FLYWHEEL DATA CONSULT WHITE ENGINES INC ENGINEERING
2.28
.09
7.80 DIA.
C.C.W. ROTATION
6.22
28°
1/8-18 UNS. 2A THD
.09 DIA. HOLE
OPTIONAL CONFIGURATION VERTICAL TACH DRIVE HERE OPERATES 1/2 ENGINE SPEED, C.W. ROTATION
INSTALLATION OF TURBOCHARGED 6 CYL. DIESEL ENGINE APPLICATION
J-40A85984

WHITE ENGINES, INC
CANTON OHIO 44707

POWER CHART Nº. DX-1815P

PRELIMINARY

MODEL	NO. OF CYL.	BORE	STROKE	DISPLACEMENT
D-3400-T	6	4.00 IN.	4.50 IN.	339.CU.IN.
GENERATOR SET APPLICATION		(101.6 MM)	(114.3 MM)	(5.56 L)



NOTE:

Data based on SAE J1349. Does not include fan or any power absorbing accessories.

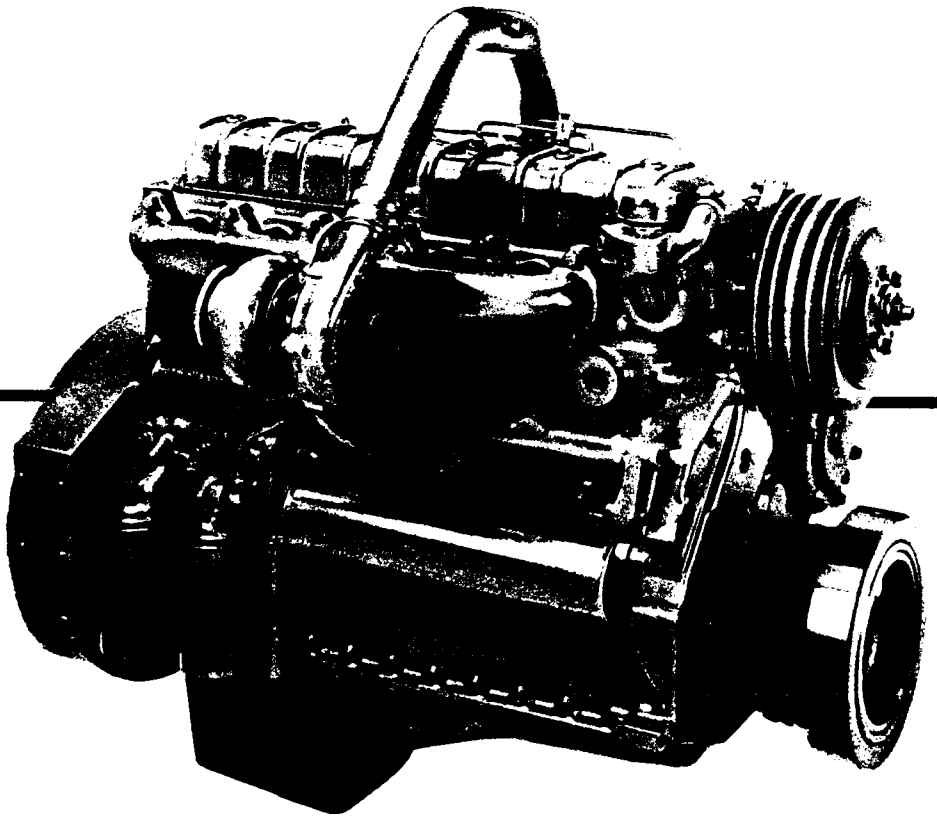
#1 Minimum continuous gross power available at 5000' @ 107°F.

#2 Minimum continuous gross power available at 8000' @ 95°F.

INTERNATIONAL®

DT 360

165 HP @2700 RPM
(FEDERAL 49 - STATE)



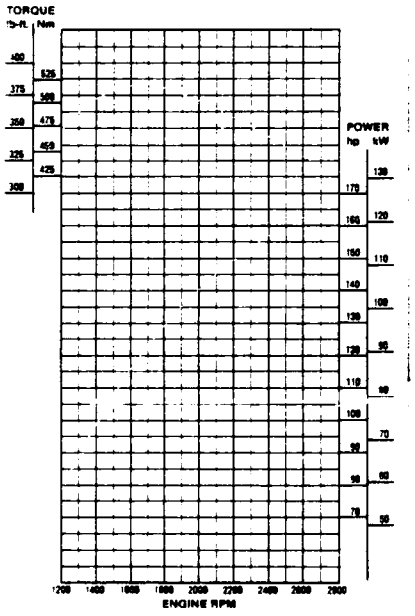
from NAVISTAR™

- Replaceable, wet-type hardened cylinder sleeves
- Jet oil-cooled pistons with Ni-Resist top ring insert
- Replaceable intake and exhaust valve seat inserts and guides
- Positive valve rotators
- Forged steel crankshaft with induction-hardened journals and fillets
- Unaided cold starts to 10°F (−12°C)
- Low noise level

- Fuel-injection system with hand primer pump
- Governor, mechanical flyball, all-speed type
- Turbocharger with inlet and outlet connections
- Engine-mounted lube-oil cooler
- Centrifugal water pump with drive pulleys
- Flywheel for 14-in. (355.6 mm) single-plate clutch
- Flywheel housing, SAE #2, with pad-type mount
- Spin-on, full-flow lube-oil filters and fuel filters
- Coolant filter/conditioner
- Oil fill and level gauge
- Coolant outlet fitting
- Engine lifting eyes

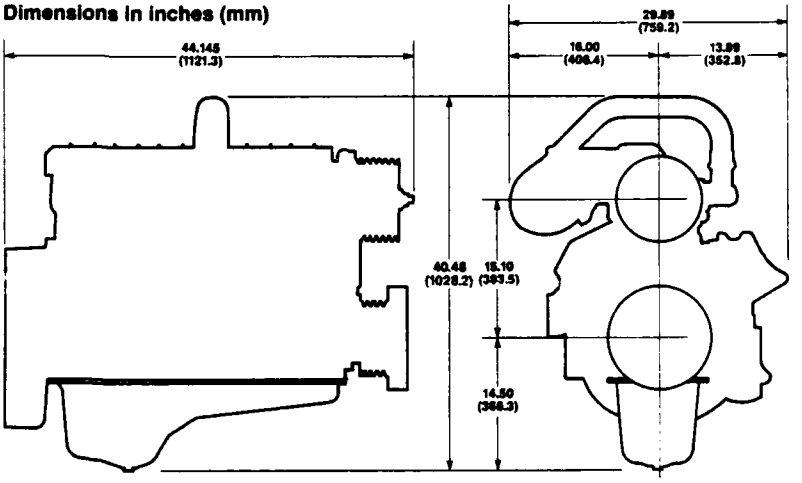
Engine type	Diesel, 4-cycle
Configuration	*Inline 6-cylinder*
Displacement	359.9 cu. in. (5.9 liters)
Bore and stroke	4.010 x 4.750 in. (101.8 x 120.6 mm)
Compression ratio	16.5:1
Aspiration	Turbocharged
Rated power @ rpm	165 hp (123 kW) @ 2700
Peak torque @ rpm	380 lb-ft (515.2 Nm) @ 1700
Rotation, facing flywheel	Counterclockwise
Combustion system	Direct injection
Total engine weight (dry)	1200 lb. (545 kg)

Water flow @ 2700 rpm	84 gpm
Fan-to-crank ratio	0.9:1
Heat rejection @ 2700 rpm (full load)	30.3 btu/hp-min.
Air flow @ 2700 rpm	483 cfm
Exhaust gas flow @ 2700 rpm	1255 cfm
Max. restrictions	
Intake system	10″ H_2O initial 30″ H_2O final
Exhaust system	27″ H_2O
Cooling-system capacity (engine only)	14 U.S. quarts
Lubricating-system capacity (including filters)	17 U.S. quarts



Performance curve for engine with air cleaner, less fan, and alternator and air compressor not charging, rated at SAE J1349 test conditions at sea level and 77°F (25°C) air temperature.

Dimensions in inches (mm)

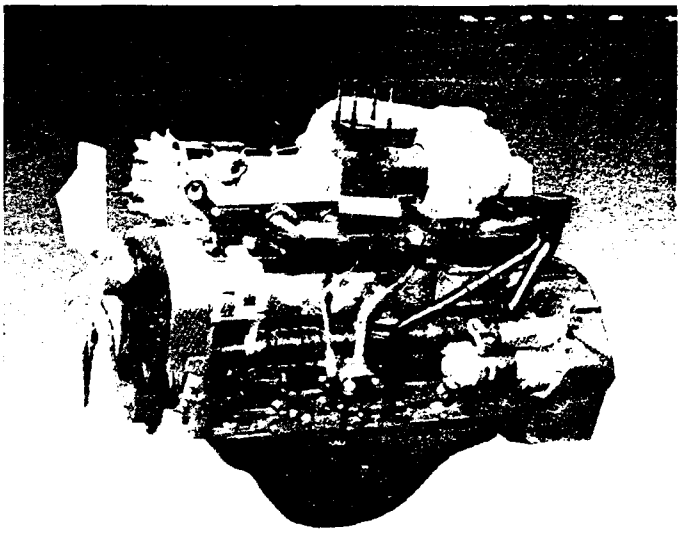


Version shown in photograph may include non-standard accessories.
Specifications subject to change without notice.
Lithographed in United States of America.

Navistar International Corporation
401 North Michigan Avenue
Chicago, IL 60611

MAIN SPECIFICATIONS

Engine Type .. 6 Cylinder, 4 Cycle, Water Cooled, Turbo Charged diesel
Bore x Stroke ..... 4.02 in. x 4.64 in. (102 mm x 118 mm)
Piston Displacement ..... 353 cu. in. (5,785 cm^3)
Dry Weight ..... 1091 lb. (495 kg)
Dimensions L x W x H
(Basic Engine) ..... 44.6 x 24.76 x 37.3 in. (1133 x 629 x 949 mm)
Compression Ratio ..... 17.5 to 1
Water Capacity ..... 12.7 Quarts (12 L)
Lube Oil Capacity ..... 21.1 Quarts (20 L)



MAIN FEATURES	STANDARD	OPTIONAL
Alternator AC	12 Volt — 50 A	12 Volt — 80 A
Voltage Regulator	12 Volt	—
Starter	12 Volt — 2.5 kW Red.	—
Exhaust Outlet	Vertical — Up	Vertical Down
Air Inlet	Vertical Up	—
Flywheel Housing	SAE #3	—
Flywheel SAE	For 11½" Overcenter Clutch	—
Oil Pan	Center Sump — 30° Inclination	RR Sump
Water Outlet	Vertical Up	Horizontal — Left
Fan (6 Blade)	21.65 in. (550 mm) Blower	18.7 in. (475 mm) Suction

INDUSTRIAL RATINGS*

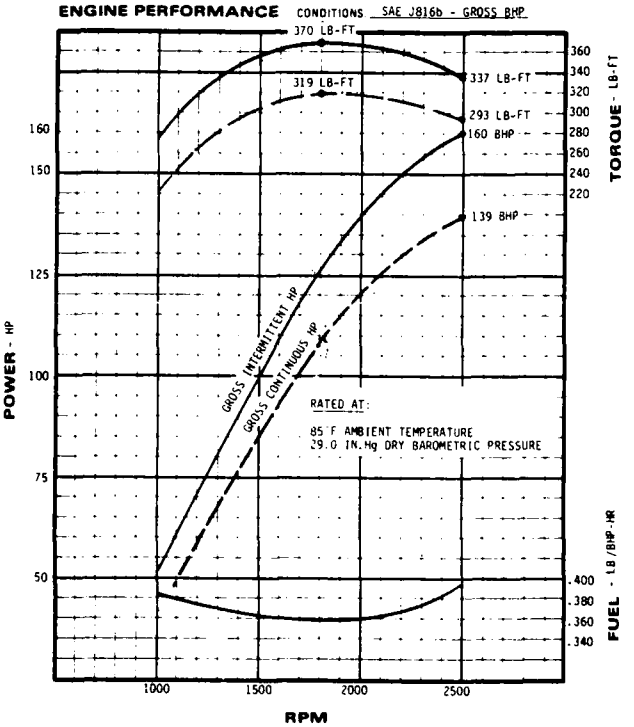
Intermittent:
60° F & Sea Level ..... 167 HP @ 2500 RPM
85° F & 500 Ft. SAE ..... 160 HP @ 2500 RPM

Continuous:
60° F & Sea Level ..... 145 HP @ 2500 RPM
85° F & 500 Ft. SAE ..... 139 HP @ 2500 RPM

Torque:
60° F & Sea Level ..... 385 LB-FT @ 1600 RPM
85° F & 500 Ft. SAE ..... 370 LB-FT @ 1600 RPM

*Gross BHP — does not include fan, muffler or air cleaner.

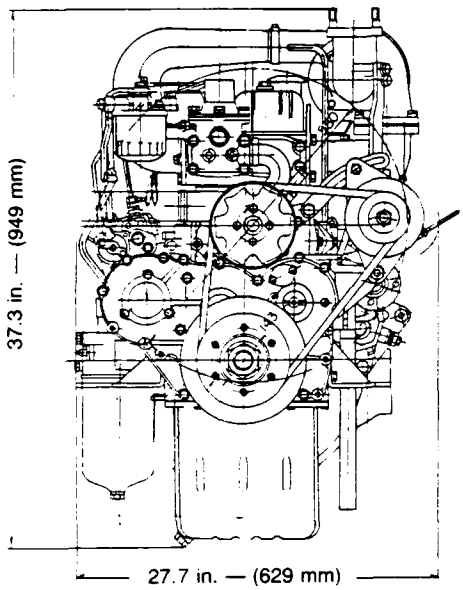
Specifications subject to change without notice.

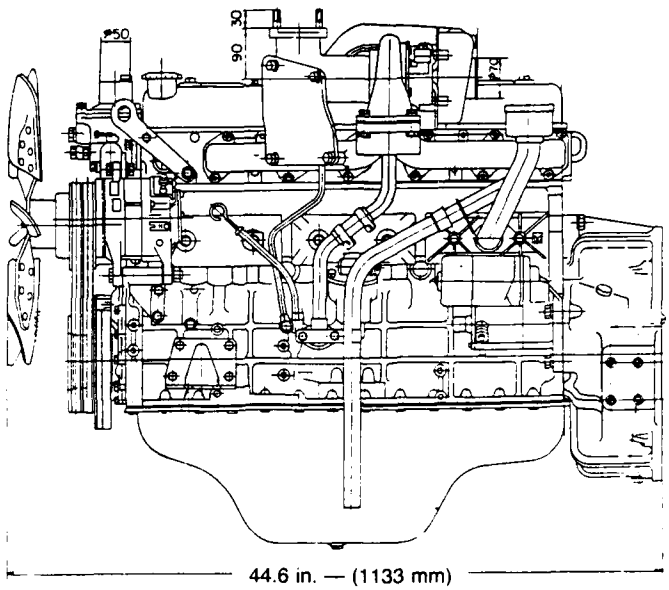


Special Features

- Direct Injected
- Replaceable Cromard Liners
- Oil-Cooled Pistons
- Glow Plug Starting Assist
- Tuftrided Crankshaft

Dimensions

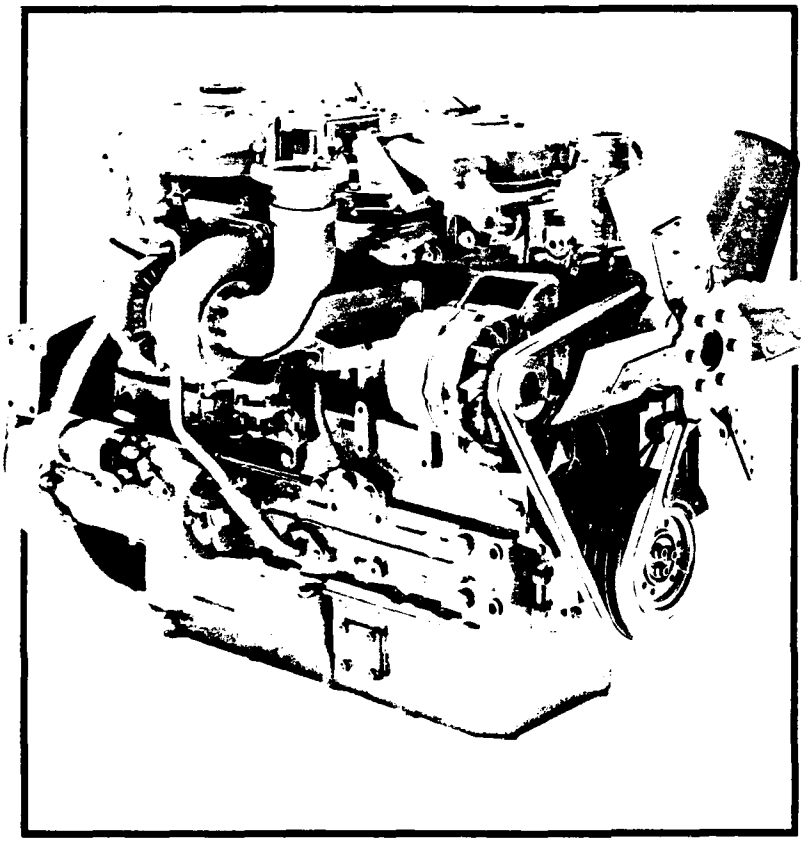




ISUZU DIESEL. THE EFFICIENCY EXPERT

ISUZU DIESEL OF NORTH AMERICA • 41169 VINCENTI COURT • NOVI, MICHIGAN 48050 (313) 474-8000

INDUSTRIAL POWER



T6.3544 TURBO

Design Features

Cylinder Block—High strength cast iron alloy monobloc construction for long engine life. Deep skirt block design adds additional strength.

Cylinder Liners—Shouldered press-fit, cast iron, dry-type liners. Easily replaceable.

Cylinder Head—High-strength cast iron alloy with fully-machined intake and exhaust ports for increased performance.

Crankshaft—Forged chrome/molybdenum steel. Statically and dynamically balanced.

Front and Rear Seals—Silicon rubber with metal insert and circumferential retaining spring eliminates external oil leaks and contamination.

Main Bearings—Seven pre-fit precision main bearings; thin-wall, steel-backed, aluminum/tin-lined. Retained by heavy-duty SG iron bearing caps.

Pistons and Rings—Three-ring, controlled expansion, aluminum alloy pistons with steel skirt inserts and armored top ring grooves. Pistons are cooled by oil jets on the crankcase wall.

Connecting Rods—Molybdenum/steel alloy with high-strength H-section shank. Fitted with precision-type aluminum/silicon-lined big-end bearings and lead/bronze small-end bushings. Fully-floating piston pins.

Valves—Intake valves are high sili-chrome steel, exhaust valves are Stellite-faced for heat resistance and long in-service life. A seal is fitted at the top of each valve.

Camshaft—Heavy-duty cast iron alloy with case-hardened cams. Four pressure-lubricated supporting bearings. Cams and tappets splash-lubricated.

Timing Drive—All steel, positive drive gear train with precision-machined helical gears for trouble-free performance. Provision is made for precise adjustment of fuel pump timing.

Intake Manifold—Lightweight aluminum alloy casting.

Exhaust Manifold—Heavy-duty cast iron.

Fuel System—Rotary distributor-type fuel injection pump provides even fuel distribution to all cylinders. Automatic advance and retard mechanism ensures quick starts and smooth performance from idle to full power. Injectors are easily accessible on the cylinder head for maintenance purposes.

Lubrication System—High capacity, full-pressure feed, rotary pump-driven lubrication system. Control valve in pump body maintains constant optimum pressure for efficient lubrication. Full-flow, spin-on no-spill filter.

Cooling System—High-capacity cooling system featuring full-depth, full-circumference cylinder circulation. Twin thermostats fitted for added security. High and low water pump positions.

Turbocharger—Compact design. Exceptionally quiet. Dynamically balanced for flawless operation at speeds up to 100,000 rpm.

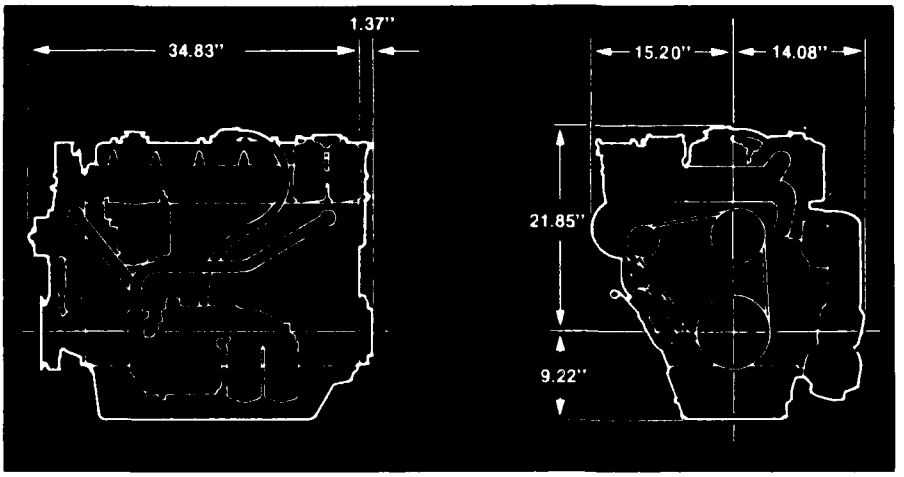
Electrical Equipment—12-volt, 42-amp alternator and 12-volt Delco starter.

Accessory Drive—Front crankshaft pulley will accept axial or belt P.T.O. provision.

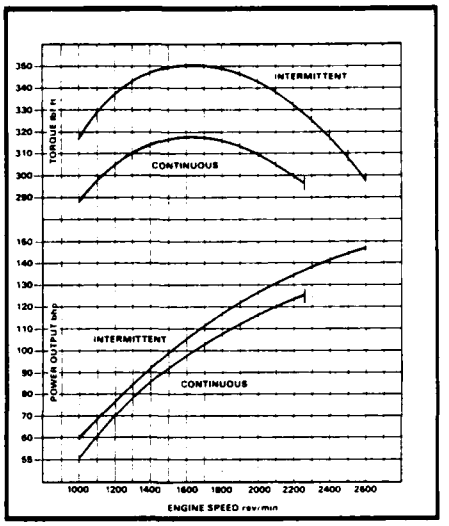
Standard Equipment

- Oil Pan—Standard industrial 25° gradient (maximum intermittent in all directions)
- Crank Pulley—Triple-groove cast iron
- Fan—22" 6-blade suction (puller) with ½" extension
- Mechanical Governor—2600 rpm, with 8% run-out
- Flywheel—Suitable for 10" or 11½" Twin-Disc or Rockford clutch
- Flywheel Housing—SAE #3
- Fuel Filter—Replaceable cartridge-type
- Oil Filter and Cooler—Spin-on type filter
- Starting Aid—Thermostart
- Electric Shut-off—Integral in fuel pump

Dimensions (typical)



145 bhp at 2600 rpm



Rating standard SAE J1349

6T.3544 Performance

Horsepower and torque ratings shown on this graph represent engine performance at standard conditions of 29.38" Hg (500 ft) air pressure and 85°F intake-air temperature.

These graphs indicate the performance of the Perkins T6.3544 diesel engine with fuel system, water pump, lubricating oil pump, and air cleaner in place. Fan and optional equipment power losses are not included in these ratings.

Optional Equipment

- Oil Pan—Center well 45° gradient (maximum intermittent in all directions)
- Pusher and suction (puller) fans
- Vacuum pumps, air compressors, and adaptors for hydraulic pumps
- SAE flywheels for friction clutches, flexible couplings, P.T.O. clutches, and torque converters
- Mounting brackets, pedestal feet, and soft mounts
- Instrumentation
- Heavy-duty air cleaner
- Starting Aid—Ether quick-start equipment, less gas cylinder
- High Output Alternator—12 volt 61-amp Delco

Perkins
Engines

North America
Perkins Engines, Inc.
P.O. Box 697
Wayne, Michigan 48184
(313) 595-9600

In Canada
(416) 281-3706

MS 188R 9/
(Specifications subject to change without notice.) Printed in U.

EASYLINK MBX 0245994C001 10JU 87 13:44/07:11 EST
FROM: 5106016463 PERKINS GL UQ
PERKINS GREAT LAKES
TO: 62921873 VIA: 7108321155
VSE CORPORATION
ATTN: MR. G.W. PERKINS
INSTALLED WEIGHT DENOTES BASIC ENGINE FITTED WITH MANIFOLDS, WATER
PUMP, OIL PUMP, FUEL PUMP, FUEL AND LUBE OIL FILTERS, ALTERNATOR, FAN, FLYWHEEL HOSING AND FLYWHEEL AIR CLEANER AND STARTER MOTOR.
1221LBS.
THIS DOES NOT INCLUDE ENGINE COOLANT. IF YOU NEED ANY ADDITIONAL DATA
PLEASE CALL ME.
REGARDS,
PERKINS GREAT LAKES, INC.
WILLIAM D. WINEMASTER

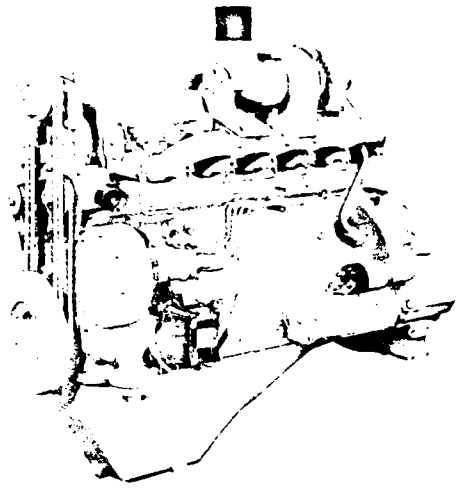
EASYLINK MBX 0248467C001 10JUL87 13:52/07:12 EST
FROM: 5106016463 PERKINS GL UQ
PERKINS GREAT LAKES
TO: 62921873 VIA: 7108321155
VSE CORPORATION
ATTN: G.W. PERKINS
REFERNECE TO EARLIER TELEX,
WEIGHT INCLUDES FLYWHEEL HOUSING AND NOT HOSING!
SORRY THE ERROR.
PERKINS GREAT LAKES, INC.
MMMM
EASYLINK MBX 0256106C001 10JUL87 14:14/07:12 EST
VIA: 62921873
TO: 62921873
VIA WUI
62921873ESL UD
MMMM
EASYLINK MBX 0272430C001 10JUL87 14:58/07:12 EST
VIA: 62921873
TO: 62921873
VIA WUI
62921873ESL UD

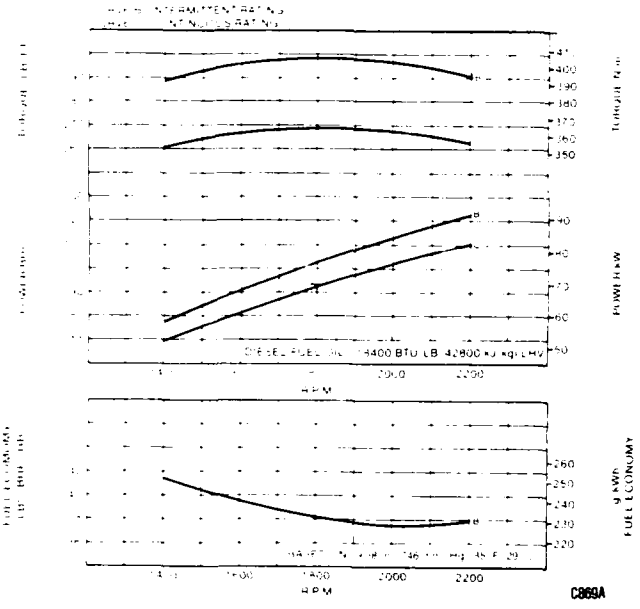
Waukesha DRESSER

WAUKESHA ENGINE DIVISION
DRESSER INDUSTRIES INC.
WAUKESHA WISCONSIN 53187

VRD330S DIESEL

CODE H FAN HUB-TO-FLYWHEEL





RATING STANDARDS

Listed ratings for engine include lubricating, fuel and jacket water pumps. Performance ratings corrected to 500 ft. (152 m) altitude, 29.38 in. (746 mm) hg, and temperature of 85° F (29° C).

DEDUCTIONS FOR ALTITUDE AND TEMPERATURE

Intermittent operation — 2% for each 1000' (305 m) above 500' (152 m) altitude and 1% for each 10° F (6° C) over 85° F (29° C).

Continuous operation — 2% for each 1000' (305 m) above 1500' (457 m) altitude and 1% for each 10° F (6° C) over 85° F (29° C).

ENGINE DATA

4 cycle, 6 cylinder, in-line
Bore and stroke — 3.875 (98 mm) x 4.665 (118 mm)
Displacement — 330 cubic inch (5.4 liters)
Dry weight — approximately 1100 lbs. (483 Kg)
Horsepower — 122 BHP intermittent @ 2200 RPM
Rotation — counterclockwise when facing flywheel

FEATURES

- Heavy duty, deep skirted crankcase
- Centrifugally cast, replaceable wet cylinder liners
- Forged steel, dynamically balanced and counter-weighted crankshaft with hardened journals
- Forged steel connecting rods
- Seven main bearings
- Replaceable, precision type main and rod bearings
- Overhead valves with replaceable valve guides
- Open combustion chamber
- Cross flow head design
- Aluminum alloy, with Ni-Resist insert ring carrier, 3 ring pistons with full floating pins
- Distributor type fuel injection pump, speed advance, and integral governor
- Turbocharger

STANDARD EQUIPMENT

Fuel injection system including fuel filter and fuel supply pump
Water pump and thermostat
Lube oil pump, full flow oil filter
Intake and exhaust manifolds
Lifting eyes
Adj. fan bracket, pulley and belts
Flywheel with ring gear, machined for 11.5" (292 mm) overcenter clutch with 2.83" (72 mm) O.D. pilot bearing
Oil cooler
SAE No. 3 pad type flywheel housing
Torsional vibration damper
Motorola, 12V, 55 amp. alternator, mtg. and drive
12 volt starter
Solenoid shut-off, 12V, on injection pump

OPTIONAL EQUIPMENT

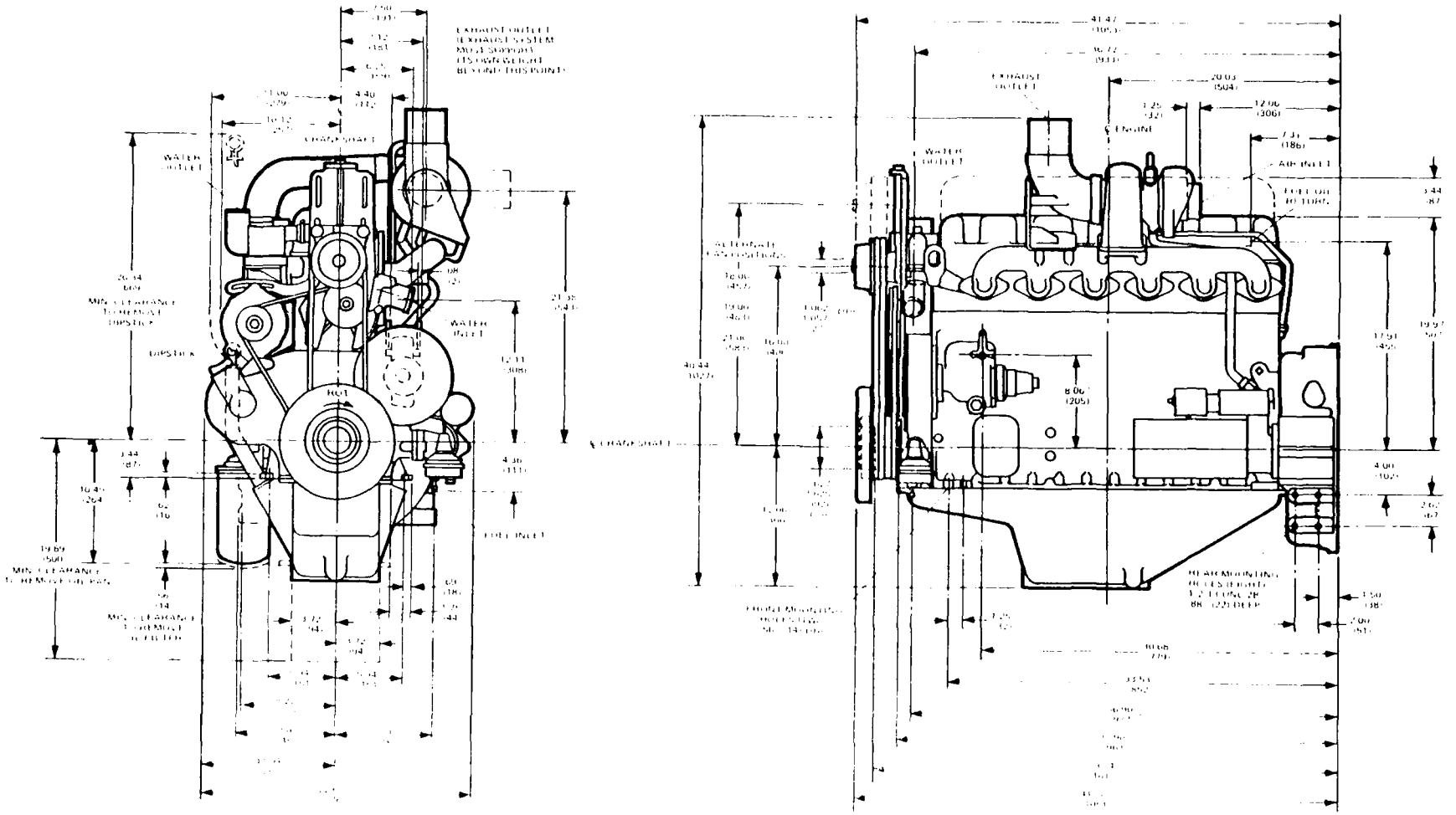
Mounting and drive only for Delco Remy 10SI alternator
Pusher or suction fans
Special flywheels
Tachometer drive
Accessory drive up to 40 HP takeoff

DIMENSIONS FOR:

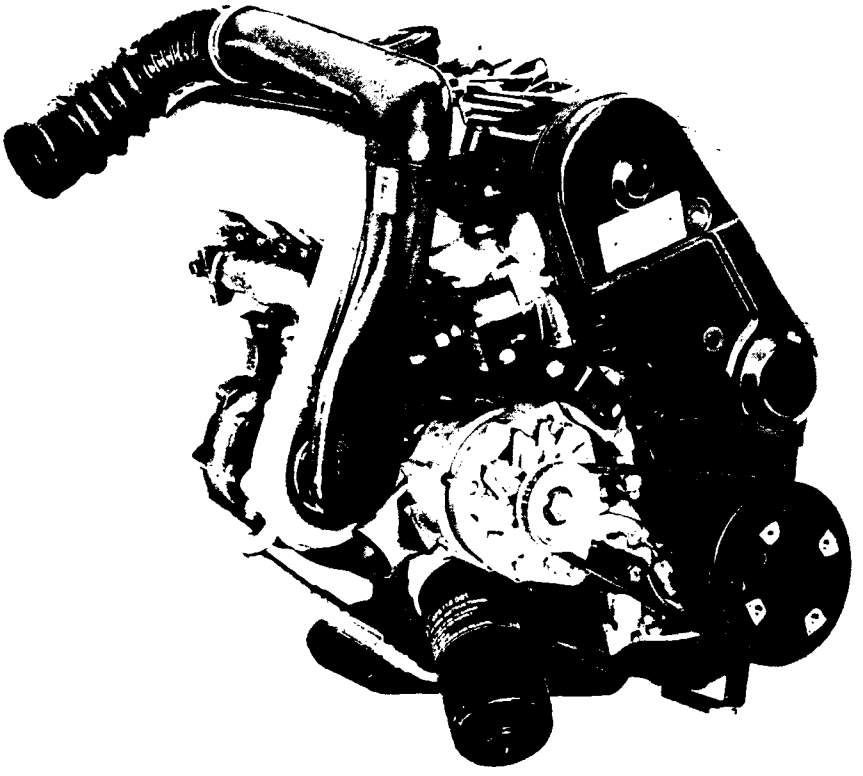
VRD330S

Waukesha DRESSER

WAUKESHA ENGINE DIVISION
DRESSER INDUSTRIES INC.
WAUKESHA, WISCONSIN 53187



Volkswagen Industrial Engines- wherever there's driving to do.



High-speed reliability
Quiet running
for dependable operation

Low noise
Low pollution emission
for environmental acceptability

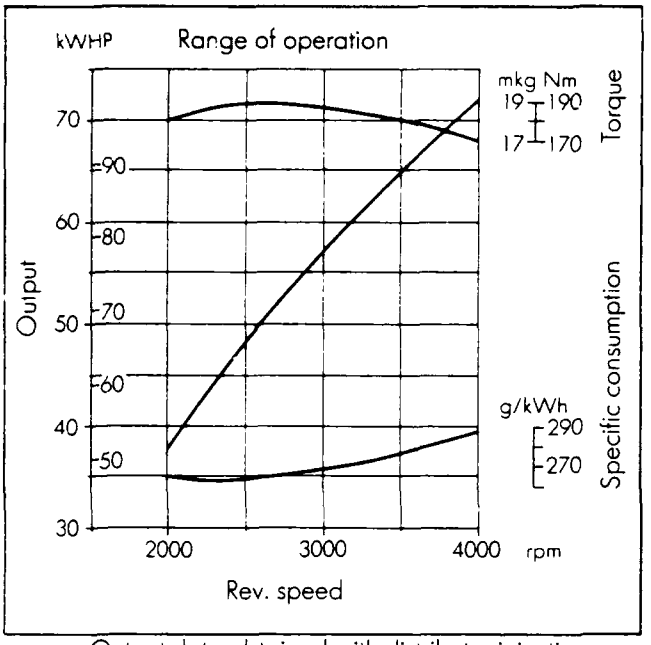
Thrifty in consumption
Convenient to service
for economy

Compact dimensions
Light weight
for simple installation

These are the advantages that led to this engine being built into our successful LT models. Advantages that you can put to good use for other purposes.
This engine is backed by the worldwide V.A.G Organization providing service and spare parts.

Water-cooled diesel Industrial Engine with exhaust-driven turbocharger. 2400 cc.

075.2



Output (Din 70020) – without cooling fan –			
Rev. speed rpm	DIN kW	DIN HP	Max. torque
2000	38	52	189 Nm (18,9 mkp) at 2600/min
2500	49	67	
3000	58	79	
3600	65	88	
4000	72	98	

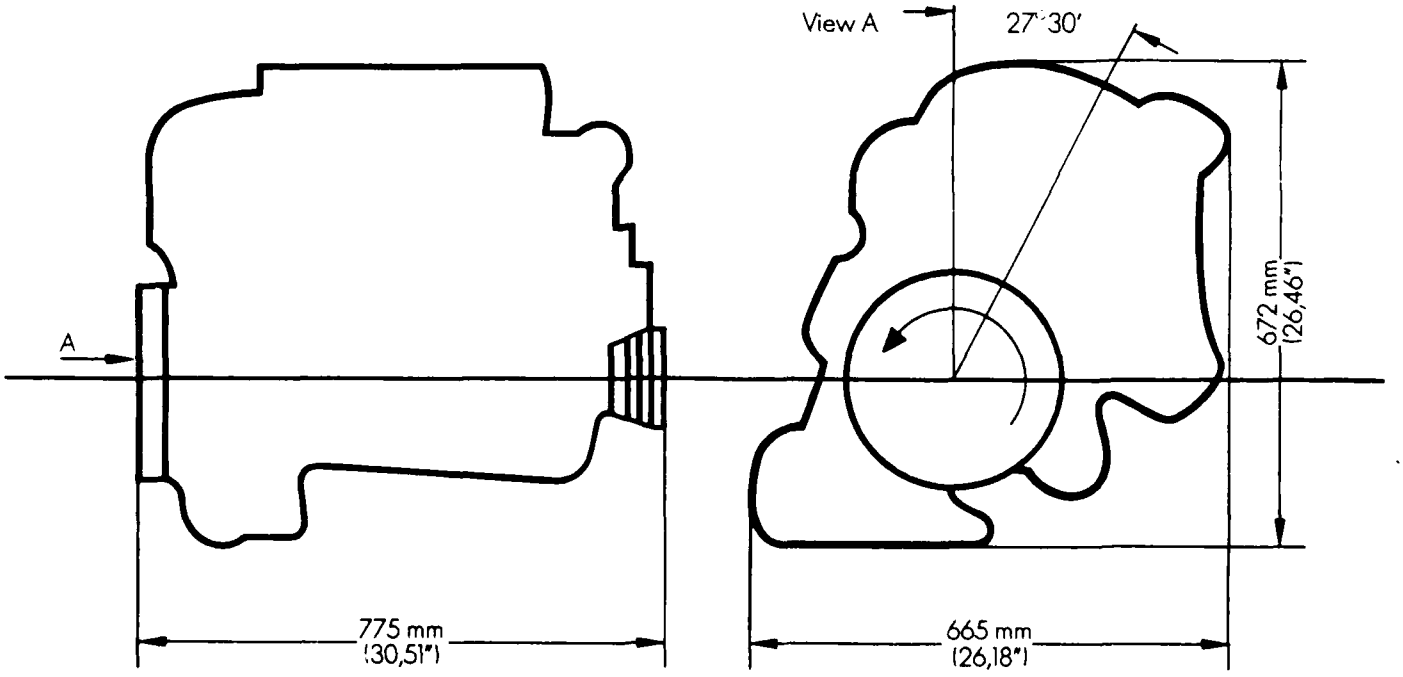
Output data obtained with distributor injection pump and variable speed governor.

Specifications.

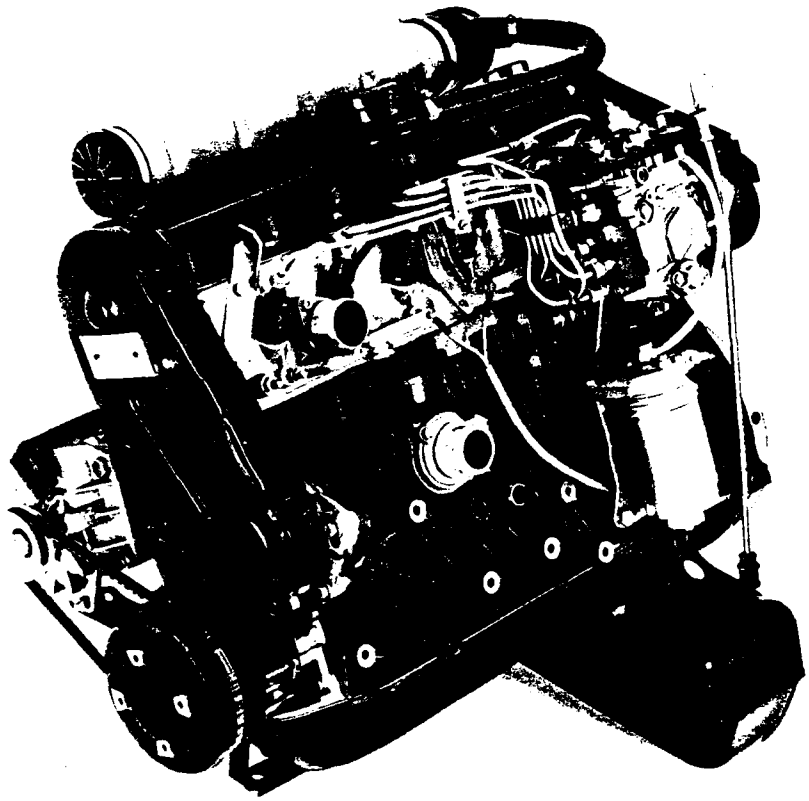
Design: Six cylinder, diesel, in-line engine with overhead camshaft (OHC) and exhaust driven turbo-charger. The swirl chamber ensures optimal combustion.
Valves operated directly by the camshaft via bucket tappets. Distributor injection pump and camshaft driven via a toothed belt. Numerous versions are available to suit a wide range of different operating and installation conditions.

Volkswagenwerk AG Wolfsburg

Bore/Stroke	76.5/86.4 mm
Capacity	2383 cc
Compression ratio	23
Lubrication	Force-feed lubrication with oil pump on crankshaft. Main flow oil filter
Oil	7.0 litres when changing filter, otherwise 6.0 l.
Fuel	Diesel fuel according to DIN 51601
Injection pump	BOSCH distributor injection pump with speed limiter and electric cut-out device. Variable speed governor at extra charge.
Electric system	12-V system with alternator 45 A and starter 2.2 kW (3.0 HP).
Cooling	Pumped liquid cooling (sealed pressurized system). Cooling liquid: water/anti-freeze.
Dry weight	196 kg
Inclination	27° 30' to the right when facing the flywheel.



Volkswagen Industrial Engines- wherever there's driving to do.



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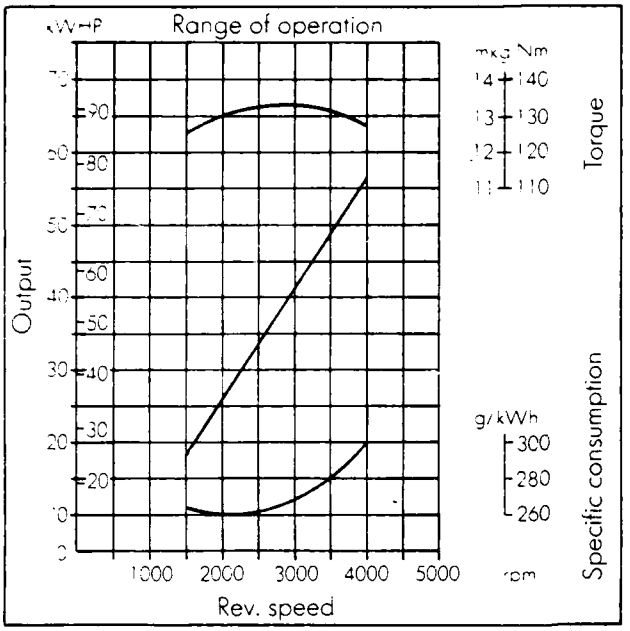
Water-cooled diesel Industrial Engine. 2400 cc.

075.1



Output (DIN 70020) – without cooling fan –			
Rev. speed rpm	DIN kW	DIN HP	Max. torque
2000	27	37	131 Nm (13.1 mkp) at 2700/min
2500	33	45	
3000	40	54	
3600	48	66	
4000	56	76	

Specifications.
Design: Six-cylinder, diesel, in-line engine with overhead camshaft (OHC). The swirl chamber ensures optimal combustion.
Valves operated directly by the camshaft via bucket tappets. Distributor injection pump and camshaft driven via a toothed belt. Numerous versions are available to suit a wide range of different operating and installation conditions.

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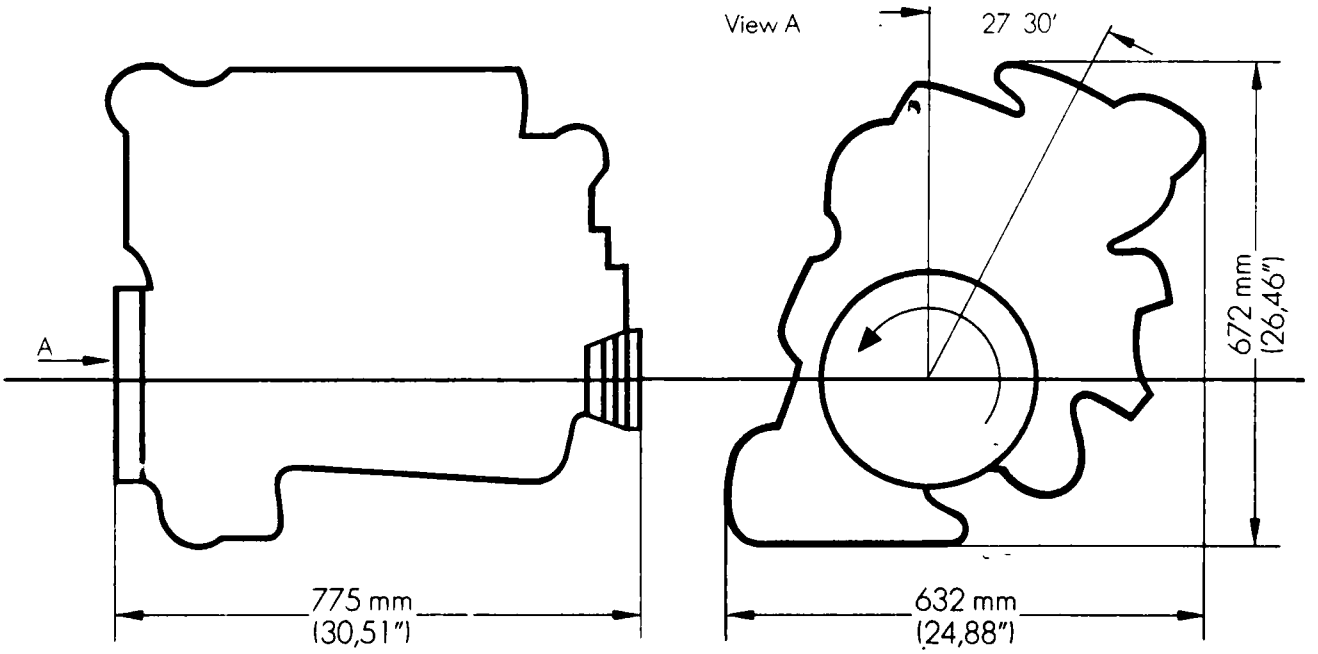
Capacity	2383 cc
Compression ratio	23
Lubrication	Force-feed lubrication with oil pump on crankshaft. Main flow oil filter
Oil	7.0 litres when changing filter, otherwise 6.0 l.
Fuel	Diesel fuel according to DIN 51601
Injection pump	BOSCH distributor injection pump with speed limiter and electric cut-out device. Variable speed governor at extra charge.
Electric system	12-V system with alternator 45 A and starter 2 kW (2.7 HP).
Cooling	Pumped liquid cooling (sealed pressurized system). Cooling liquid: water/anti-freeze.
Dry weight	191 kg
Inclination	27° 30′ to the right when facing the flywheel.



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